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SOLID WASTE BENCHMARKING STUDY OF 13 THAI MUNICIPALITIES

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Executive Summary

Benchmarking of municipal services such as solid waste management (SWM) is a common practice throughout the world. It involves measuring performance and level of service through standardized and comparable numerical indicators. Against these indicators, a local government unit (LGU) can use the collected information to compare their performance in managing solid waste against the performance of other LGUs – in their region, in their country, or worldwide – and, in the process, they can better determine potential performance improvements. Additionally, if benchmarking is adopted long-term as a means of performance measurement, a LGU can change the way business is run and can promote a culture of continuous improvement.

Thailand Municipal Benchmarking Study:

From December 2002 to April 2003, a Thai university consortium led by Khon Kaen University undertook a benchmarking survey of the current solid waste management practices of thirteen municipalities in Thailand. This study was funded through a grant from the US-Asia Environmental Partnership (US-AEP) through their Technical Support Services Contract (TSSC). The results were used to provide input into the World Bank's Thailand Environmental Monitor 2003 and to provide tangible data for those working towards the improvement of solid waste management in Thailand.

The survey team was comprised of well-known environmental specialists from four leading universities in different regions of Thailand: Chiang Mai University, Khon Kaen University, Chulalongkorn University, and Prince of Songkla University. The survey team implemented three main activities: (1) designed the survey methods & questionnaires, (2) conducted the survey in three or four municipalities in their region, and (3) compiled the survey data. The team from Khon Kaen, along with assistance from the TSSC Office in Thailand, then took responsibility for writing the benchmarking report.

Participating Cities:

The thirteen cities that participated in this solid waste management survey (see Table 1 on page 3 and map on page 4) offer a good sample of small and medium-size cities in each region of Thailand. They range in size from 39,065 people (Kanchanaburi) to 270,609 people (Nonthaburi). Further, these cities are experiencing a diversity of problems and challenges in managing their solid waste and are trying various methods, some quite creative, to overcome them.

Executive Summary

Table 1: Participating Cities

City	Registered Population (2001)	Land Area (km^2)	Sub-Districts	Solid Waste Management	
				Collection	Disposal **
Northern Region					
Chiang Mai	173,856	40	14	75% privatized ‡	Private engineered landfill
Phitsanulok	87,976	18	1	Municipal-operated	Municipal engineered landfill
Lampang	69,334	22	8	Fully-privatized	Private engineered landfill
Northeastern Region					
Khon Kaen	179,153	46	1	Municipal-operated	Municipal engineered landfill
Nakorn Rachasima	174,322	38	24	Municipal-operated	Open dump (army site)
Ubon Rachathani	105,150	29	4	Municipal-operated	Open dump (army site)
Central Region					
Rayong	55,942	17	4	Municipal-operated	Municipal sanitary landfill
Kanchanaburi	39,065 *	9	5	Municipal-operated	Municipal open dump
Nonthaburi	270,609	39	5	Municipal-operated	Provincial open dump
Pattaya	85,533 †*	53	4	70% privatized ‡	Municipal engineered landfill
Southern Region					
Hatyai	157,806 †	21	--	Municipal-operated	Municipal controlled dump
Surat Thani	114,840 *	69	6	Municipal-operated	Municipal open dump
Phuket	72,754	12	17	50% privatized ‡	Private incinerator; Provincial engineered landfill

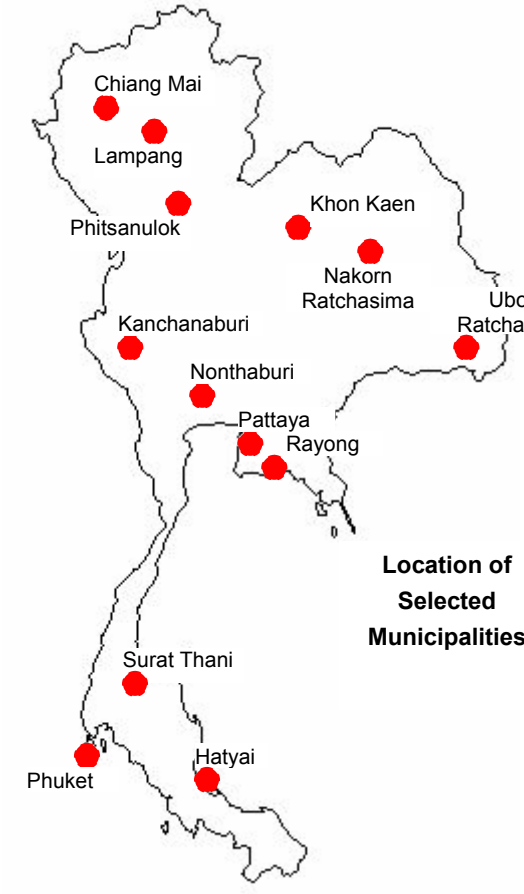
* 2002 population
† Pattaya and Hatyai have a high unregistered population, estimated to be 500,000 and 150,000 respectively. Most of these people work in the tourist industry.
‡ Measured by the percent of the municipal area served by private collection.
** The definitions of "open dump", "controlled dump", "engineered landfill", and "sanitary landfill" are provided by the World Bank and are detailed on page 10.

Common Problems in Managing Solid Waste:

In addition to collecting hard data on the solid waste management practices of the 13 municipalities, the survey team asked local officials about the problems they face in managing their solid waste. The most common that were reported are discussed below. To highlight that some municipalities are effectively facing their solid waste management challenges, some success stories are also presented in text boxes.

1) Unfavorable private sector contracts: As shown in the table above, some municipalities have privatized some or all of their disposal and/or their collection services. This can be a positive development. In some cases, the private sector can offer services more effectively and efficiently than the public sector. However, many of the municipalities in this survey reported problems with their private contractors, some of which are of their own making. For instance, while Phuket is one of the only municipalities (if not the only one) in Thailand that charges the community for both solid waste collection and disposal fees, the city negotiated a set deal with the fee collection company whereby only 1.4 million baht/year is returned to the municipality. Meanwhile, in Pattaya, officials reported that the

solid waste collection company was only serving 70% of its contracted area due to problems in the company's collection efficiency. One municipality – Phitsanulok – finally decided, after experiencing problems with its private company, to take back management responsibilities. Officials report that they now experience fewer problems.



Location of Selected Municipalities

2) Inefficient fee collection: A few municipalities reported that one of their major problems is their low rates of fee collection. The data collected from the municipalities also suggest that this is a major problem. The data on operating costs to operating revenue (summary on page 19) implies that all the surveyed municipalities operate well under deficit status and that municipalities that have privatized some or all of their services are worse off in this regard.

Rayong

Rayong Municipality implements a number of successful initiatives, including a solid waste bank, organic waste separation, a program that allows resident to trade waste for eggs, and hazardous waste separation. All hazardous waste is separated at home and picked up separately before sent to the hazardous waste disposal company.

Phitsanulok

Phitsanulok is well known for its success-ful recycling program. According to the Pollution Control Department, the Municipality processes over 3,600 tons of recyclables a year. Part of their success is attributed to source separation at the household level. Due to the Mayor's vision and concern about the environment, this Municipality has many successful waste management pro-grams, including recycling, separation of organic waste and separation of hazardous waste.

3) Difficulty in waste collection: Chiang Mai and Phitsanulok reported problems in the condition of their collection trucks. In Chiang Mai, the survey found that only 85 % of trucks are in operating condition, which then led to collection problems. In addition, a number of municipalities reported that their trucks have difficulty collecting from all households due to narrow and disorganized roads.

4) Not-in-my-backyard (NIMBY) syndrome: Most of the municipalities that do not currently dispose of their waste in a sanitary or engineered landfill – Hat Yai, Khon Kaen, Nakhon Rachasima, Ubon Rachathani, Kanchanaburi, Surat Thani – reported having problems either building or operating new landfills due to resistance from the public (see page 10).

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5) Inadequate condition of disposal sites: A number of municipalities reported problems with the condition of their landfills or transfer stations. Common problems reported include insufficient leachate collection, treatment systems and groundwater monitoring. In Phitsanulok, for instance, officials reported that the size of their leachate collection and treatment lagoon is insufficient. Far worse, the site in Kanchanaburi has no leachate drainage or treatment system and no groundwater monitoring. In addition, a few municipalities reported that there is no separation of hazardous waste from their solid waste; thus, in these municipalities, there is a risk that hazardous waste can contaminate the landfill area and water resources in the vicinity.

Nonthaburi

Unlike many municipalities that have either privatized their solid waste disposal or continue to handle it themselves, Nonthaburi disposes of its solid waste in the Provincial Administration's open dumpsite at a low service charge of 27.10 baht per ton. The Municipality claims that this is less of a problem and is more cost effective than operating its own disposal site.

6) Scavengers: Six cities – Rayong, Phuket, Pattaya, Hat Yai, Surat Thani, and Kanchanaburi – reported the presence of scavengers, whose health is seriously endangered by exposure to unsanitary conditions. The fences around the facilities in these municipalities do not seem to be much of a deterrent. Hat Yai reported the largest number of scavengers, despite the fact their landfill has a fence around it. Chiang Mai and Lampang reported that they have no scavengers and that fences were a factor in this.

Summary of Survey Data from 13 Thai Municipalities

This section provides a summary of the data and information that was collected from local officials in the thirteen municipalities that participated in this solid waste benchmarking study. Most of the section provides a comparison of the municipalities against select indicators. The full data sets can be found in Annexes E and F.

The section is divided into two parts. The first part focuses on municipal management of solid waste, including solid waste collection, solid waste disposal, recycling, and municipal staffing in solid waste management. The second part covers municipal spending and funding for solid waste management and covers overall spending, operation and maintenance expenditures, capital expenditures, and fee collection. In addition to collecting hard data, the survey team asked local officials about the problems they face in managing their solid waste. This information is presented along with the data in this section.

As is also stated in Annex B (Methodology and Data Limitations), the survey team found that most municipalities lack accurate data in many areas and especially for their annual expenditures for operation and maintenance and for capital equipment. In many cases, local officials were unable to provide data for certain indicators, which complicated making detailed comparisons between municipalities. However, an analysis of the data did allow the survey team to draw some general comparisons and to make a number of useful observations about current trends in municipal solid waste management.

One of the comparisons made throughout this report is between municipalities that have privatized some or all of their solid waste management services and those that rely on their own municipal-run services. For ease of comparison, information on the former group of municipalities – Lampang, Chiang Mai, Phuket, and Pattaya – is presented at the front of the many bar charts presented in this section. It is worth noting that only municipal data is presented for these four municipalities. Data from their private companies was not collected, largely because of resistance by the private sector to share information.

Part 1: Summary of Collection, Disposal, Recycling and Staffing

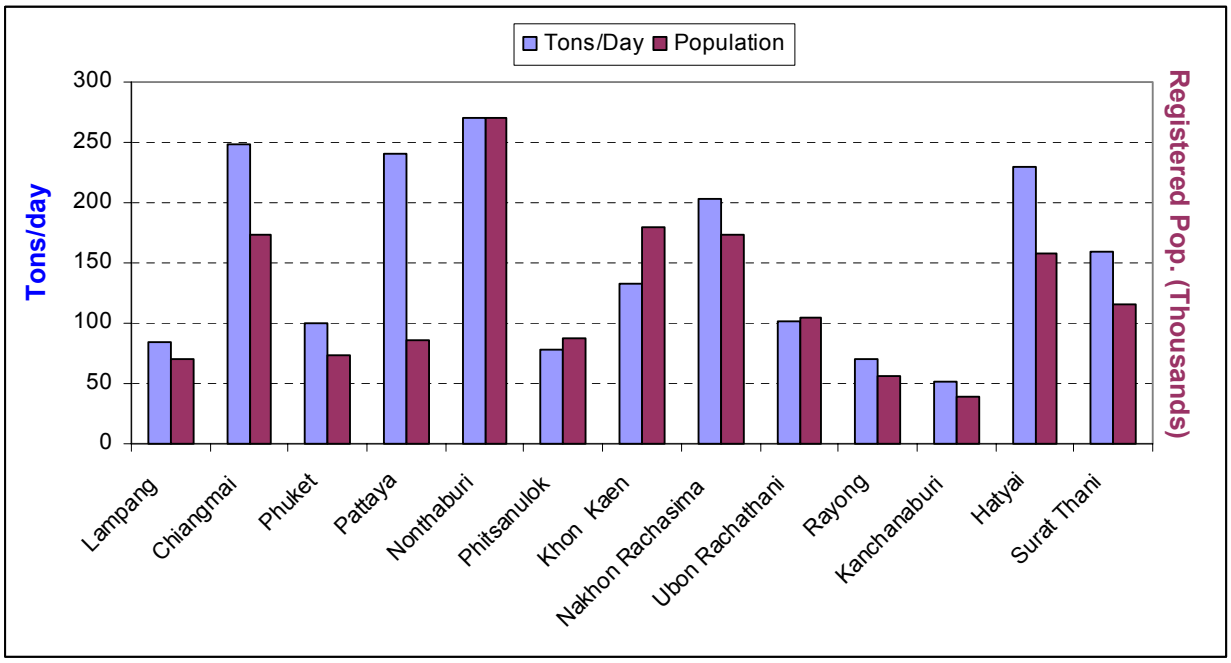
A. Solid Waste Collection

In nine of the thirteen municipalities surveyed, the collection of solid waste is undertaken by the municipality itself. As measured by the percent of the municipal area served by private collection, Lampang's collection services are fully privatized, while Chiang Mai (75%), Pattaya (70%), and Phuket (50%) are partially privatized.

Tons of Solid Waste Collected. Most municipalities do not have reliable estimates for the amount of solid waste that is produced within their localities, so this survey focused instead on the amount of solid waste that is collected. In the thirteen surveyed municipalities, the reported amounts varied from 51 tons/day in Kanchanaburi to 270 tons/day in Nonthaburi in 2001 (see Figure 1). In most cases, municipalities arrive at these estimates by weighing their collection vehicles.

As is apparent from Figure 1, the amount of solid waste collected is closely correlated with a municipality's registered population. The average ratio is about 1.3 tons per 1,000 people per day (or 1.3 kilograms per person per day). The ratio for Pattaya, at 2.8 kilograms per person per day, is over double this average. This may be due to the fact that the municipality has a high unregistered population (associated with their tourist industry) that is not accounted for in the ratio. Another explanation is that Pattaya's tourist-based economy generates more waste per capita than other municipalities.

Figure 1: Collection of Solid Waste and Registered Population (2001)



Another exception is Chiang Mai. City officials reported the second highest amount of solid waste collected annually, but, unlike Nonthaburi (which ranked highest), solid waste generation seems to be outpacing the city's population. The rapid growth of Chiang Mai, with its dense population and

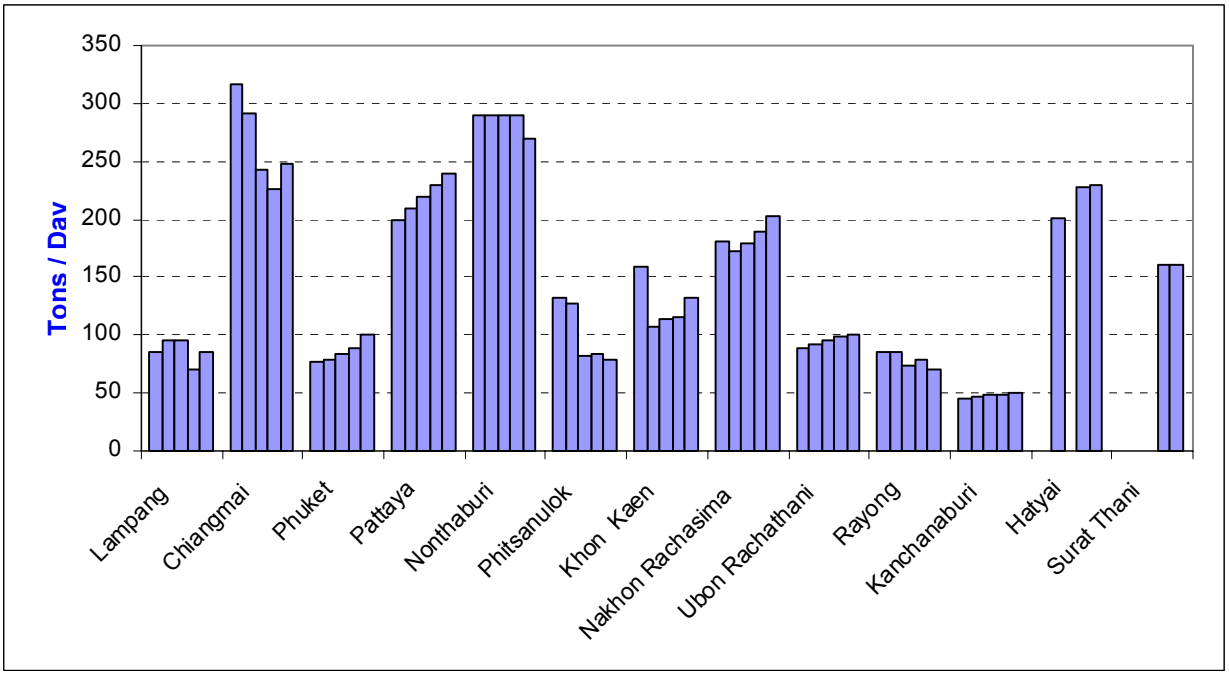
increasing city activities, may offer a reason for this. Industrial enterprises have added to the volume of solid waste in the city and the rising number of visitors, both Thai and foreign, is also a likely factor.

Nevertheless, as shown in Figure 2, the amount of solid waste collected in Chiang Mai in 2001 was lower than was the case in 1998, a trend shared with five other municipalities that were surveyed. Over the five-year period from 1997 to 2001, Phuket (30%) and Pattaya (19%) reported the highest increases.

Collection Efficiency. All thirteen municipalities reported that their collection services extend to 100% of their city districts, while nine of the thirteen municipalities reported collection rates (i.e. the percent of solid waste produced that is collected) in the range of 95% to 100%. These numbers seem to contradict reports by some municipalities that uncollected waste remains a problem in their jurisdictions. For instance, officials in Chiang Mai and Nonthaburi reported that collection was difficult in some areas due to narrow roads (see below), but both reported collection rates at or very near 100%.

Again the main outlier for this indicator was Pattaya. At the time of the survey, officials reported that the company that handles their solid waste collection was only serving 70% of the contract area, and, as a result, the remaining uncollected solid waste was causing an odor problem in the city.

Figure 2: Collection of Solid Waste (1997-2001)



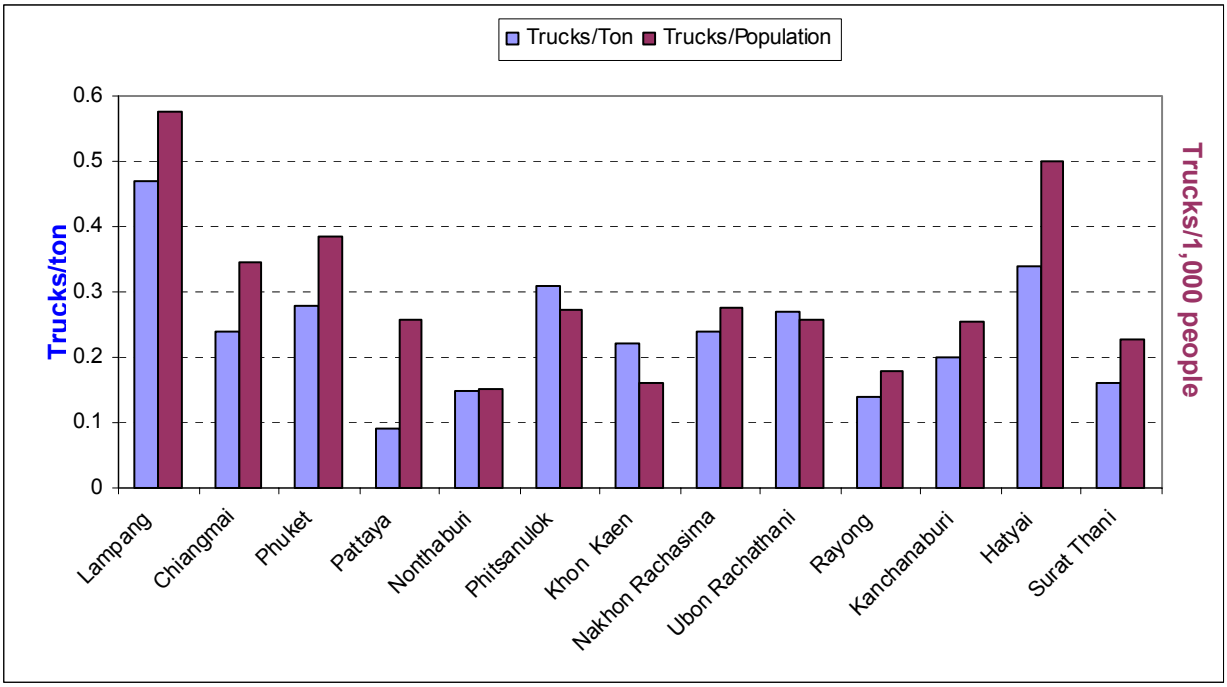
* 1997 and 1999 data unavailable for Hatyai. 1997-1999 data unavailable for Surat Thani.

Collection Trucks. Figure 3 shows the number of collection trucks that are used in each municipality (both in terms of trucks per ton of solid waste collected and per person), which may offer an indicator of a municipality's collection efficiency. However, a more important factor may be how well a municipality utilizes its fleet. For instance, both Chiang Mai and Phitsanulok reported problems in the

condition of their collection trucks. In Chiang Mai, the survey found that only 85 % of trucks are in operating condition, which then led to collection problems.

In addition, a number of municipalities reported that their trucks have difficulty collecting from all households due to narrow and disorganized roads. This problem was reported in Chiang Mai, Ubon Rachathani, and Nonthaburi. Some cities with narrow roads have devised solutions around the problem. In Hatyai, solid waste collection is conducted at night because of the traffic on narrow roads. Meanwhile, the Municipality of Khon Kaen has purchased four-wheel trucks to pick up waste on their narrow roads.

Figure 3: Number of Collection Trucks (per ton of solid waste collected & per 1,000 people)



B. Solid Waste Disposal

Method of Disposal. Twelve of the thirteen municipalities use a landfill or dump as their primary method to dispose of solid waste. Only Phuket incinerates its solid waste, but the city still employs an engineered landfill to serve as secondary disposal for scrap and a reserve in case problems arise with its incinerator.

As shown in Table 2 on page 10, only one of the municipalities – Rayong – uses a site that has all of the operational practices and environmental controls and conditions that qualify it as a sanitary landfill. Meanwhile, six municipalities (almost half of those surveyed) use an open dump or a controlled dump. Surprisingly, five of these six municipalities are among the seven municipalities surveyed that have registered populations over 100,000.

Table 2: Type of Landfill Site Used by Municipalities*

Municipality	Type of disposal site	Definitions (provided by World Bank)
Rayong	Municipal sanitary landfill	Waste accounting, placement, cover and compaction procedures, fencing and adequate staff on site. No waste pickers living on landfill. Regular environmental monitoring. Functional environmental controls including liner, drainage, leachate treatment, and gas ventilation.
Lampang	Private engineered landfill	Some basic waste accounting, placement, cover and compaction procedures, fencing and some staff on site. Waste pickers may be living on landfill. Some environmental monitoring and environmental controls, such as liner, drainage, leachate treatment, and gas ventilation. Controls may be dysfunctional or not operated.
Chiang Mai	Private engineered landfill	
Phuket	Provincial engineered landfill	
Khon Kaen	Municipal engineered landfill	
Pattaya	Municipal engineered landfill	
Phitsanulok	Municipal engineered landfill	
Hatyai	Municipal controlled dump	Unlined pit with soil cover. Some basic waste accounting, placement and compaction procedures. Limited facilities, such as fencing and some staff on site. Limited or no environmental controls. Waste pickers are commonly living on landfill.
Nonthaburi	Provincial open dump	Dumping of solid waste onto the land without soil cover. No formal operational procedures. No environmental controls. Waste pickers are commonly living on site.
Nakhon Rachasima	Open dump (at Army site)	
Ubon Rachathani	Open dump (at Army site)	
Kanchanaburi	Municipal open dump	
Surat Thani	Municipal open dump	

* These designations are not those provided to the survey team by local officials due to the fact that local officials commonly misclassify their site as a "sanitary landfill". These designations were taken from the World Bank.

Five of the six municipalities that use an open or controlled dump reported problems either building or operating new landfills due to resistance from the public. Hatyai, Nakhon Rachasima, and Surat Thani have all proposed new sites but have been unable to build them. Ubon Rachathani and Kanchanaburi have actually constructed new landfills but are unable to use them. As a result, these municipalities are forced to use older and less sanitary facilities, some of which are operating at or beyond their capacity. Nakhon Rachasima and Ubon Rachathani both use open dumps on Army property. In the case of the latter, the Army has asked the Municipality to stop dumping on its property and the Municipality must dispose of its waste at a more distant site at a rate of 130 baht/ton.

In the case of Nonthaburi, the municipality disposes of its solid waste in the Nonthaburi Province Administration's open dumpsite with a low service charge (27.10 baht/ton). The Municipality claims that it is more cost effective to utilize the Nonthaburi Province Administration's open dumpsite than to operate its own disposal site.

Reported Difficulties in Disposing of Waste. A number of municipalities reported problems with the condition of their landfills or transfer stations. As a typical example, officials at Pattaya reported many sanitary problems at their temporary transfer station, including odor, insects, and leachate containment. In Phitsanulok, the size of their leachate collection and treatment lagoon is insufficient.

Perhaps the worst problems were reported in Kanchanaburi, where their site has no leachate drainage or treatment system, and no groundwater monitoring.

Officials in six municipalities – Rayong, Phuket, Pattaya, Hatyai, Surat Thani and Kanchanaburi – reported the presence of scavengers, whose health is seriously endangered by exposure to unsanitary conditions. The fences around the facilities in these municipalities do not seem to be much of a deterrent. Hatyai reported the largest number of scavengers, despite the fact their landfill has a fence. Chiang Mai and Lampang reported that they have no scavengers and that fences helped keep them out of the site.

A few of the municipalities reported that there is no separation of hazardous waste from their solid waste. In these municipalities, there is a risk that hazardous waste can contaminate the landfill area and water resources in the vicinity. This problem was reported in Lampang, Pattaya, Chiang Mai, and Surat Thani. A number of municipalities also reported that the disposal of infectious waste is a problem. While most municipalities have a program to enforce infectious waste disposal from public health services, some public health services still lack proper on site treatment. Thus, some medical waste is still mixed with community solid waste.

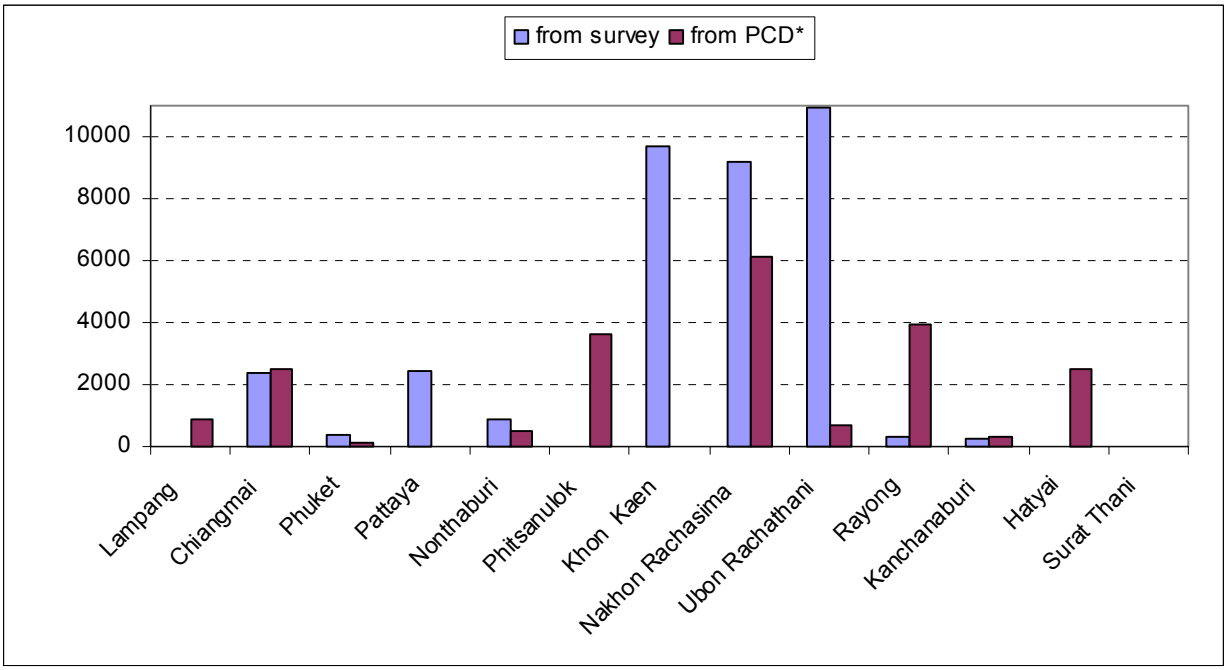
C. Recycling

Many municipalities reported having a program to separate wet (organic) and dry (inorganic) solid waste, but the Pollution Control Department (PCD) reports that many municipal efforts are unsuccessful. The PCD introduced a national program that promoted waste separation a few years ago, but the program was unsuccessful due to collection problems and difficulties in convincing people to separate their waste. A number of cities reported similar problems in convincing their citizens to separate their waste.

However, some municipalities have had some success in promoting recycling. Phitsanulok, for instance, is well known for its recycling program. According to the Pollution Control Department, the Municipality processes over 3,600 tons of recyclables a year. Part of their success is attributed to source separation at the household level. The Municipality has many successful waste management programs, including recycling, separation of organic waste and separation of hazardous waste.

Figure 4 presents the amount of recyclable waste that municipalities reported processing each year, first from this benchmarking study and second from data from the Pollution Control Department (PCD). According to the reported data, the amount of solid waste that municipalities recycle per year is low compared to the overall amount of solid waste they collect. However, it is difficult to draw many conclusions from this data because many municipalities did not report on recycling indicators and the data from those that did is inconsistent.

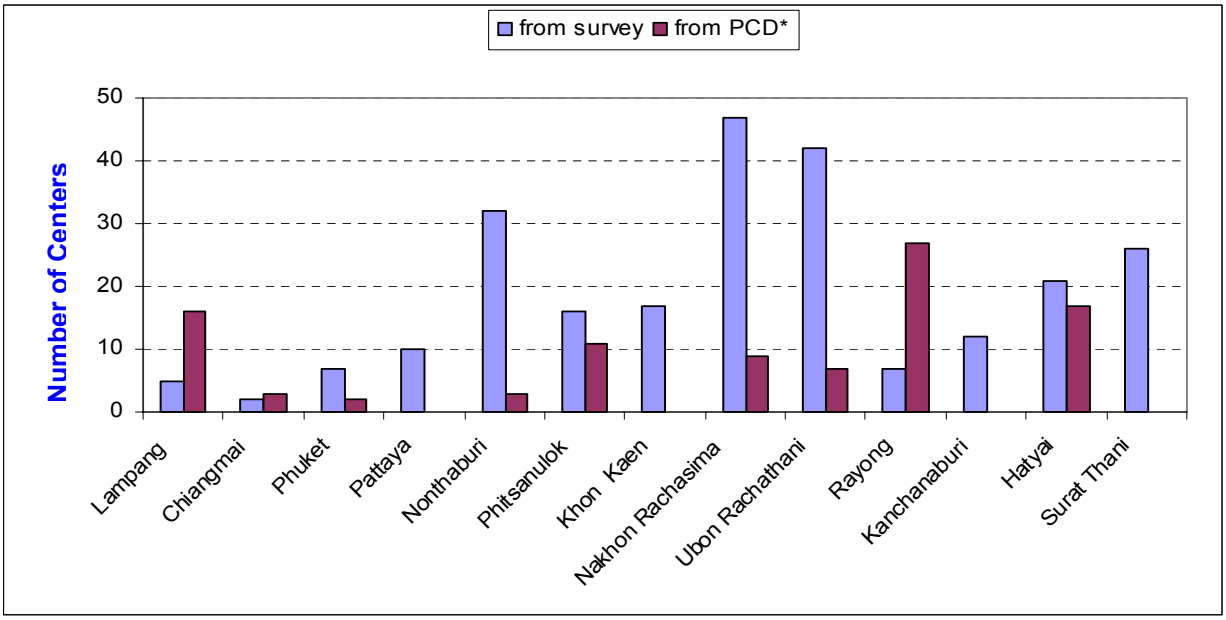
Figure 4: Tons of Recyclables Processed in 2002



* from Pollution Control Department, Thailand, http://www.pcd.go.th

Perhaps a better indicator is the number of recycling exchange centers located in a municipality (Figure 5). This is because most recycling in Thailand is done by the informal sector, which bring recyclables to facilities that exchange recyclables for money. These can include schools, community garbage banks, and private enterprises, such as shops.

Figure 5: Recycling Exchange Centers



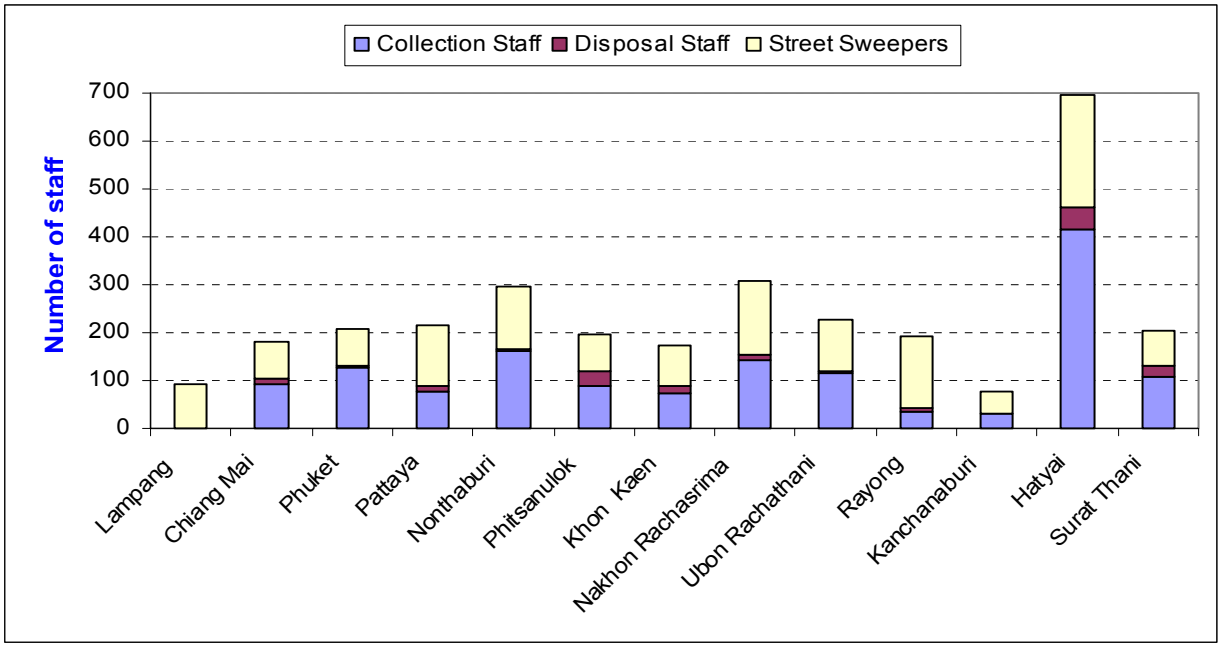
* from Pollution Control Department, Thailand, http://www.pcd.go.th

D. Municipal Staffing for Solid Waste Management

Commonly, municipalities in Thailand divide up the management of solid waste between two municipal departments. Garbage collection and street sweeping is the responsibility of the Public Cleansing Division under the Public Health and Environment Department, while the Public Works Department is responsible for the disposal of solid waste.

Figure 6 shows the number of municipal staff devoted to solid waste collection, solid waste disposal and street sweeping. Because solid waste collection and street sweeping are more labor intensive, these staff are far more numerous than disposal staff in all thirteen municipalities.

Figure 6: Number of Municipal Staff



What is most noticeable about Figure 6 is the large number of municipal staff in Hatyai. They have the most staff in all three categories but have especially large numbers of collection staff. While Hatyai's reported numbers seem high, the municipality also reported owning the most collection trucks and did not have an unusually high ratio of collection staff per collection truck (see Figure 8).

Also worth noting are the numbers for municipalities that have privatized some or all of their municipal solid waste management services. Because Lampang has a private engineered landfill and their collection services are fully privatized, the Municipality reports having no municipal staff for collection or disposal. Those municipalities that have partially privatized collection services – Chiang Mai (75%), Pattaya (70%), and Phuket (50%) – reported some municipal collection staff.

Note on Personnel Data: To reduce complexity and to make it easier to compare municipalities, these numbers do not include administrative or management staff in the different municipalities from the Public Works or Public Health and Environment Departments, most of whom work only part-time on solid waste management. Thus, collection staff includes only drivers of collection trucks and workers on the trucks, while disposal staff include mainly laborers at the disposal or transfer site. The latter category also includes sanitary engineers, mechanics, the Chief of Environmental Management, and the Chief of Sanitary Work.

Municipal Collection Staffing. As shown in Figure 7, the number of municipal staff devoted to collection and transfer of solid waste, as measured by staff per ton of solid waste collected and by staff per 1,000 people, varies from municipality to municipality, but a number of municipalities are not far from the averages of .74 staff/ton and .98 staff/1,000 people. Phuket's staffing level is most surprising given that 50% of their collection area is covered by a private company.

Figure 7: Municipal Collection Staff (per ton of solid waste collected/day & per 1,000 people)

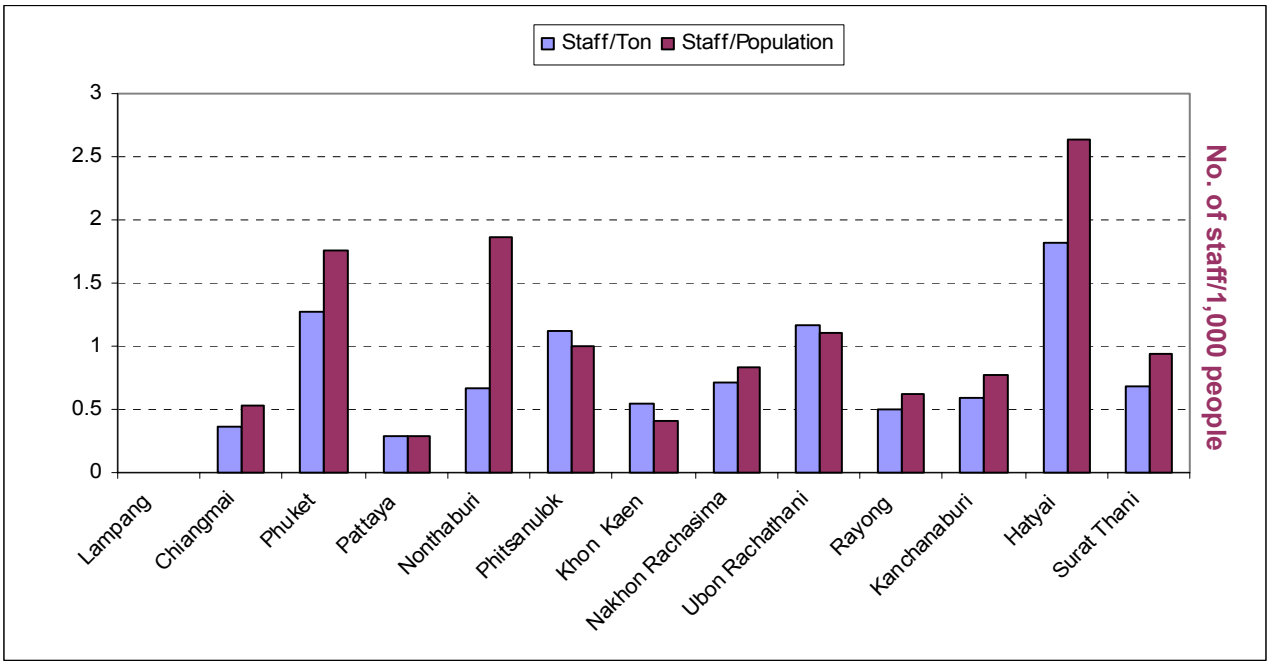
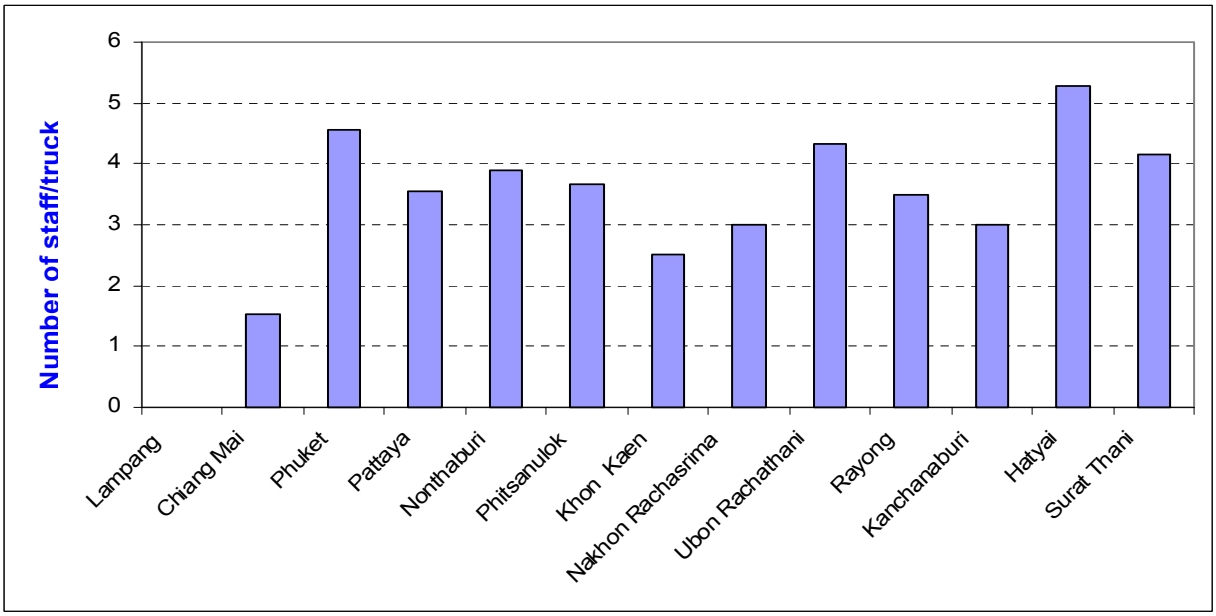


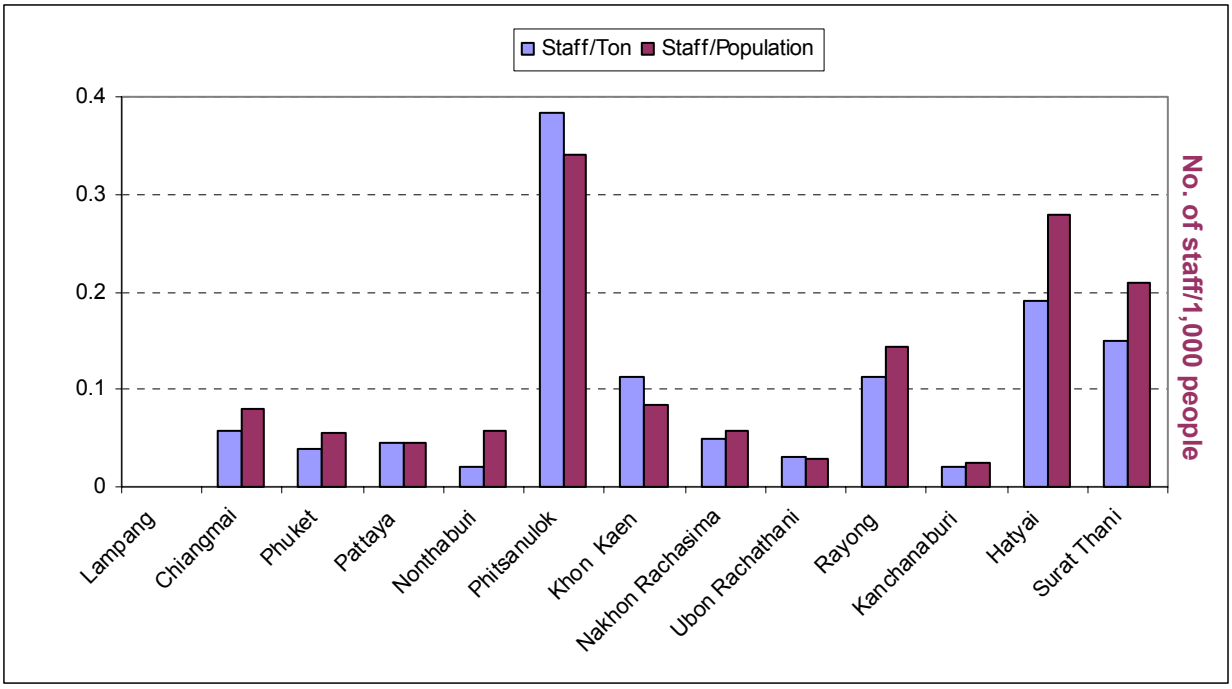
Figure 8: Municipal Collection Staff per Collection Truck



Municipal Disposal Staffing: The second set of staffing indicators measure staff employed for solid waste disposal, measured both by disposal staff per ton of solid waste disposed and disposal staff per 1,000 people (Figure 9). These numbers are more variable than those for municipal collection staffing. While the averages for both indicators are .09 staff/ton and .10 staff/1,000 people, most municipalities fall well below or well above these numbers.

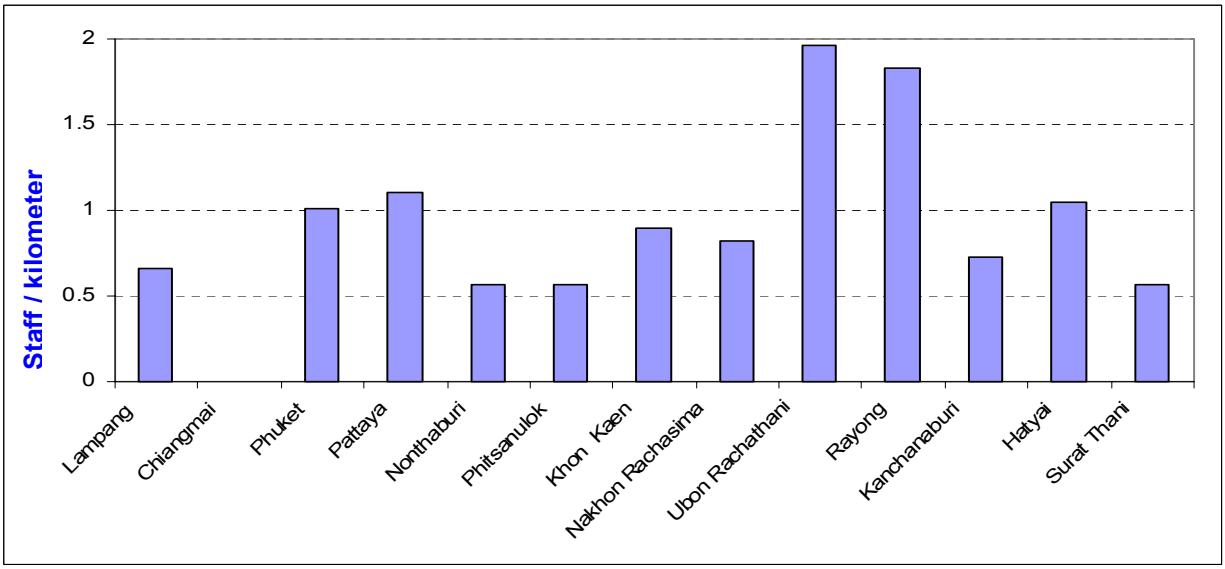
The differences in disposal staff from municipality to municipality may be influenced by many factors, but there seems to be a loose correlation between the number of disposal staff and the type of disposal site. Most of the municipalities that use controlled dumps or open dumps reported having fewer disposal staff. Hatyai and Surat Thani stand out as exceptions.

Figure 9: Municipal Disposal Staff (per ton of solid waste collected/day & per 1,000 people)



Street Sweeping Staff: The last staffing indicator shows street sweeping staff per kilometer of road swept (Figure 10). The average is .98 staff per kilometer. Interestingly, Hatyai comes in just over this average despite having by far the most street sweepers. The Municipality reports that it sweeps 224 km of road, second only to Nonthaburi (233 km). The data for Chiang Mai was not available; however, much of the road cleaning in Chiang Mai is conducted by cleaning vehicles.

Figure 10: Municipal Street Sweeping Staff per Kilometer of Road Swept



Part 2: Summary of Spending and Funding for Municipal Services

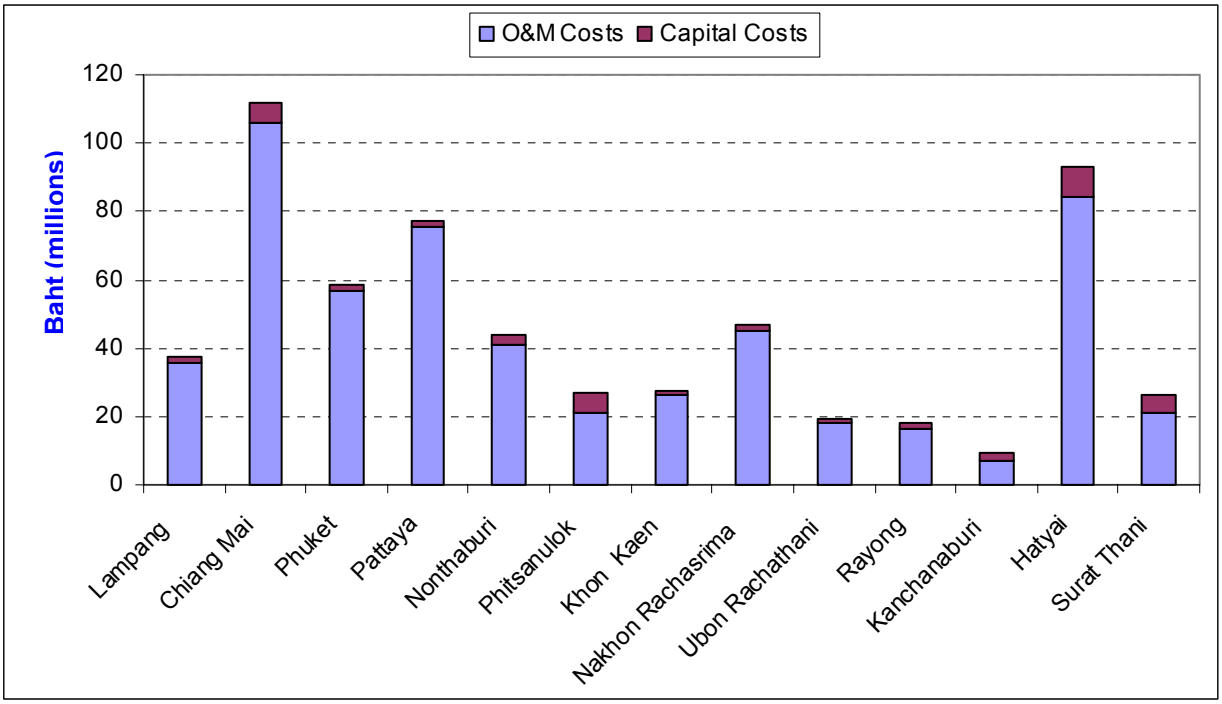
A. Overall Municipal Spending

As shown in Figure 11, municipalities vary significantly on how much they spend on solid waste management from their municipal budgets (i.e. national level spending not included in this graph), and most of this spending is for operation and maintenance. For capital costs, municipalities typically only take responsibility for procuring trucks, containers and other equipment. Large capital costs for facilities such as landfills or transfer stations are usually paid by the Office of Natural Resources and Environmental Policy and Planning (ONEP) or other sources (see page 22 for further information).

Three of the four municipalities that have privatized some or all of their solid waste management services – Chiang Mai, Phuket and Pattaya – spent far more than all but one of the municipalities (Hatyai) that rely on municipal-run services. This is due to the contracts they have with the private sector (included in O&M costs).

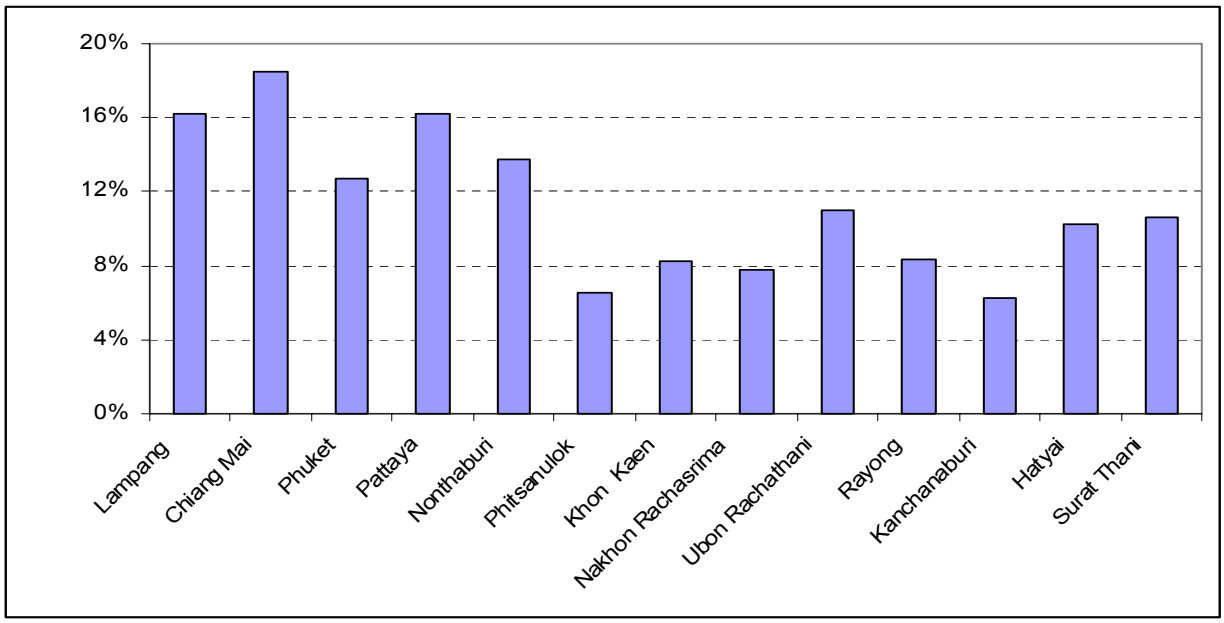
Because of these large contracts with private collection and/or disposal companies, municipalities that have privatized or partly privatized their solid waste services spend a higher percentage of their municipal budgets on solid waste management (see Figure 12) and have higher ratios of costs to revenues than those that manage their services publicly (see Figure 14).

Figure 11: Total Average Annual Municipal Spending for Solid Waste Management Services



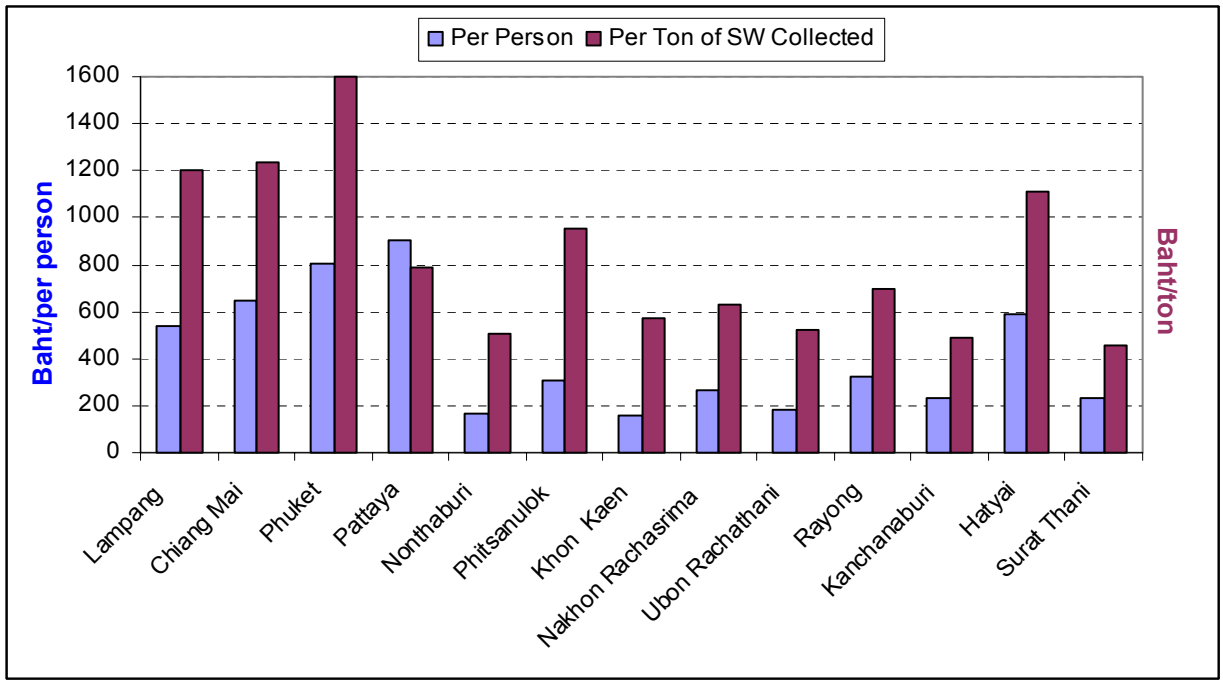
The high cost of private sector contracts seems to account for much of the variability between municipalities in how much they spend on solid waste management as a percentage of their annual municipal budgets (Figure 12). Apart from Nonthaburi, those municipalities that operate publicly spend between 7 to 11 percent of their municipal budgets on expenses related to solid waste management. Meanwhile, the four municipalities that have contracted out with private companies average over 15 percent.

Figure 12: Total Expenditures in SWM (as percent of total annual municipal expenditures in 2001)



In terms of spending per person and per ton of solid waste collected (Figure 13), the difference between the four municipalities and the others is even more pronounced. The exception is Hatyai, which spends a lot of its municipal income on collection and street sweeping staff and also vehicle maintenance.

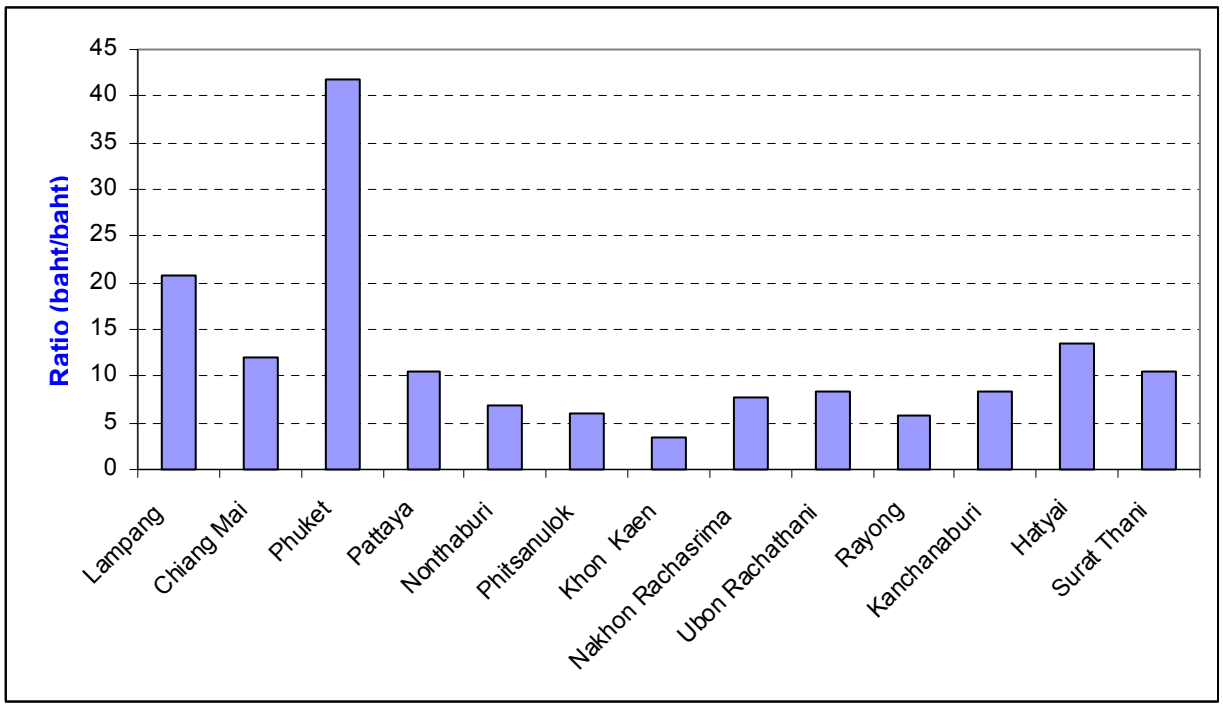
Figure 13: Municipal Spending (per person and per ton of solid waste collected)



In general, municipalities spend far more than they earn on solid waste. As shown in Figure 14, municipal performance in terms of the ratio of average annual spending to average annual fee revenues (mainly dumping fees) indicates that municipalities do not even come close to recouping their solid waste management costs.

Phuket reported that it negotiated a poor deal in privatizing its solid waste fee collection. While it is one of the only municipalities (if not the only one) in Thailand that charges the community for both solid waste collection and disposal fees, it has negotiated a set deal with the fee collection company whereby only 1.4 million baht/year is returned to the Municipality. Meanwhile, the Municipality paid over 50 million baht to the private sector in 2002. This accounts for Phuket's reported ratio of nearly 42:1.

Figure 14: Average Annual Spending on SWM / Average Annual Revenues from Fees

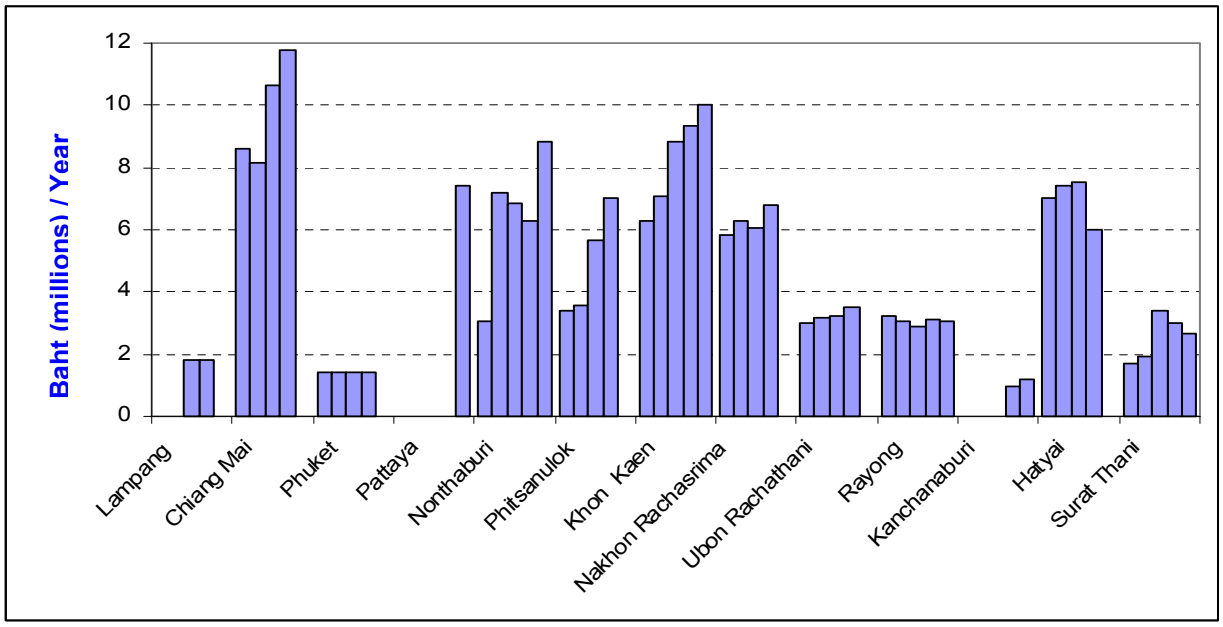


B. Fee Collection

Most municipalities process fee collection themselves, and the total amounts collected tend to be low. Figure 15 shows how much municipalities have collected from fees from 1998 to 2002 (when data was available). In a number of municipalities, the revenue from user fees has been increasing in recent years. This increase is likely due to the improvement in collection services, indicating that the municipalities are at least moving in the right direction.

Still, fee collection is still far too low to accommodate the operating costs for solid waste management. Many municipalities consider solid waste collection and disposal to be a service to the community and therefore are not looking to recover their costs. Thus, municipalities must consider increasing their collection fees and/or improving their collection efficiency if they intend to improve services.
The survey data indicates that municipalities should consider pursuing both strategies to increase their fee revenues. As shown in Annex D, fees for solid waste collection are extremely low, especially for households. This indicates that there is a lot of room to increase fee revenue by raising fee levels. Also, based solely on estimates made by the municipalities as part of this survey, collection from households ranges from fifty to ninety percent, indicating that some municipalities need to improve their collection services from households. Collection from the industry and commercial sectors, however, does not seem to be a problem.

Figure 15: Annual Revenues from User Fees (1998 to 2002)



C. Operation and Maintenance Expenditures

As shown in Figure 16, the majority of municipalities spend more on operation and maintenance for collection services than for disposal services. The more detailed breakdown in Figure 17 offers a clear explanation. Every municipality spends more on salaries for collection staff than for disposal staff (because of the higher number of collection staff) and also reported spending more on repairing and maintaining their collection equipment (mainly vehicles) than they spent on repairing and maintaining disposal equipment.

Based on the nine municipalities that manage their solid waste through public services, a typical municipality spends about 43% of its overall expenditures for solid waste management O&M on staff – 22% for collection and transfer staff, 18% for street sweepers, and only 2.5% for disposal staff. The next highest expenditure is for maintenance and repair of collection vehicles (37%), followed by the maintenance of disposal equipment (15.5%). A smaller amount of money is spent on other expenses related to street sweeping (4%) and for costs associated with environmental inspections (1%).

Figure 16: Average Annual Operation and Maintenance Costs

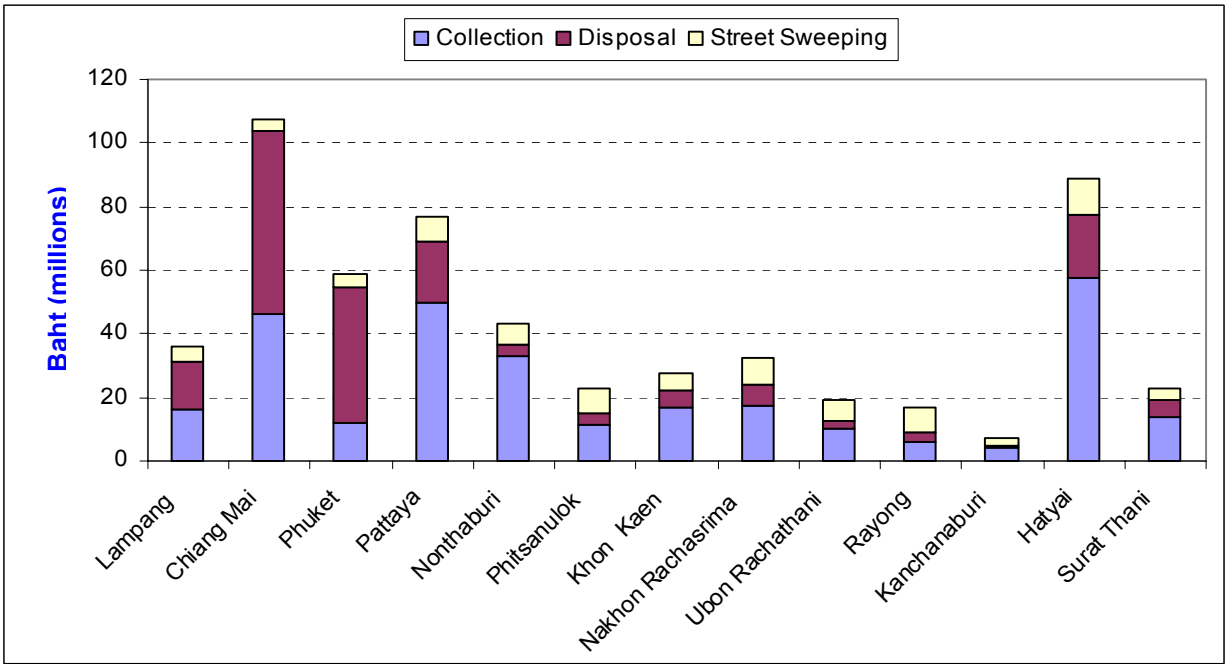
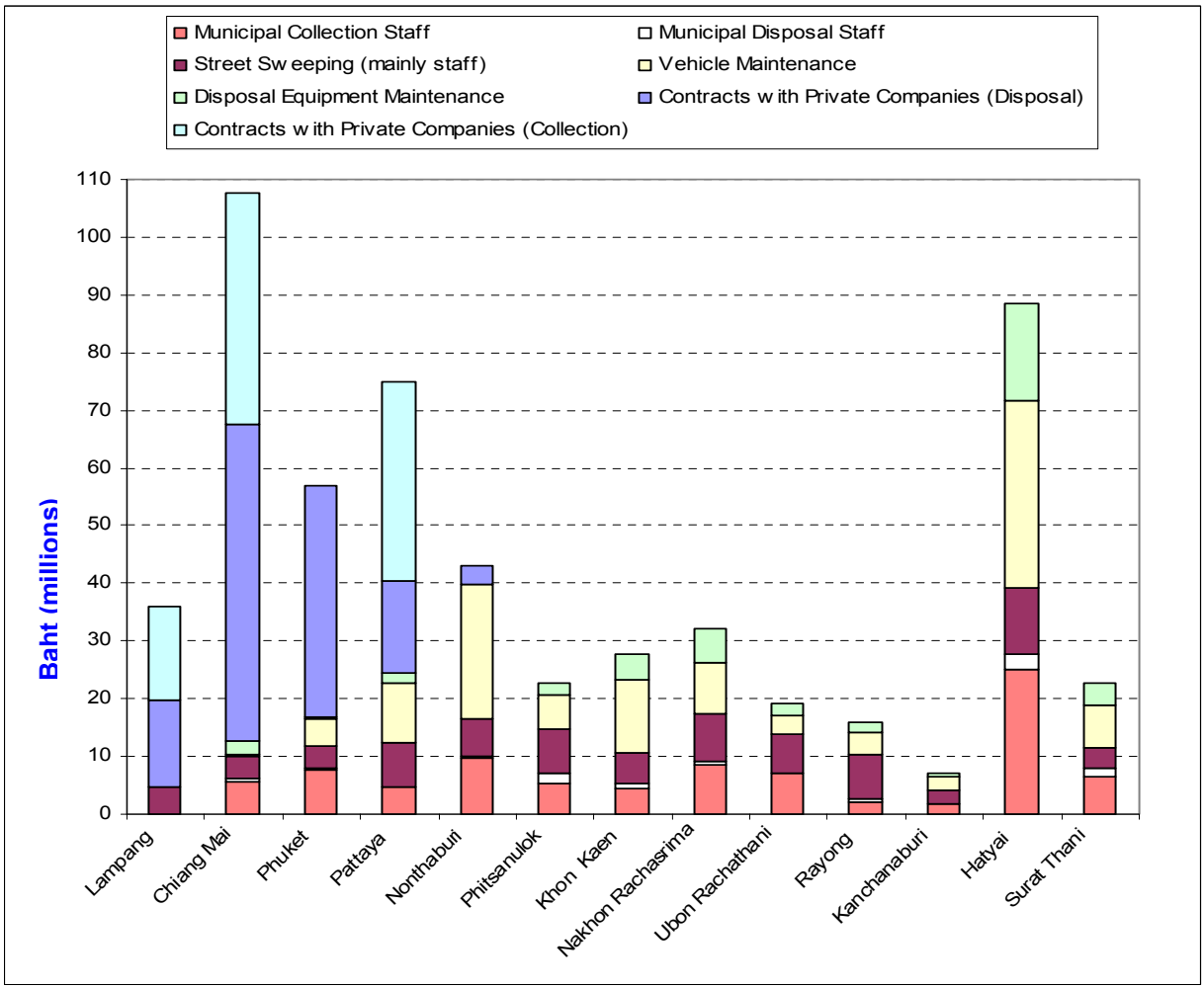


Figure 17: Average Annual Operation and Maintenance Costs (Detailed Version)



Note on O&M data: Municipalities commonly record operation and maintenance data in their annual expenditure report, which follows budgeting guidelines passed down from the central government. Expenditure line items do not match the specific solid waste expenditures requested by the survey team, which complicated data collection. Thus, O&M costs, and specifically vehicle and equipment maintenance, may either be underestimated (if the municipality simply did not report data) or overestimated (if, for instance the municipality attributed all of its "asset maintenance" expenses to solid waste). However, the survey team did its best to gather accurate data. In addition, personnel costs only include workers (e.g. truck drivers, workers at the disposal site, street sweepers). Municipal staff that spend only part of their time on solid waste management, such as municipal engineers, are not included. The calculation for personnel cost equals the number of workers multiplied by the basic wage (5,000 baht/month for collection and disposal staff and 4,100 baht/month for street sweepers.

D. Capital Expenditures

Typically, municipalities procure collection trucks, containers and other small equipment from their municipal budgets, and acquire funds from the central government for larger costs, such as conducting feasibility studies, designing and constructing new disposal sites, upgrading existing sites, purchasing land, constructing transfer stations, and heavy equipment at the site.

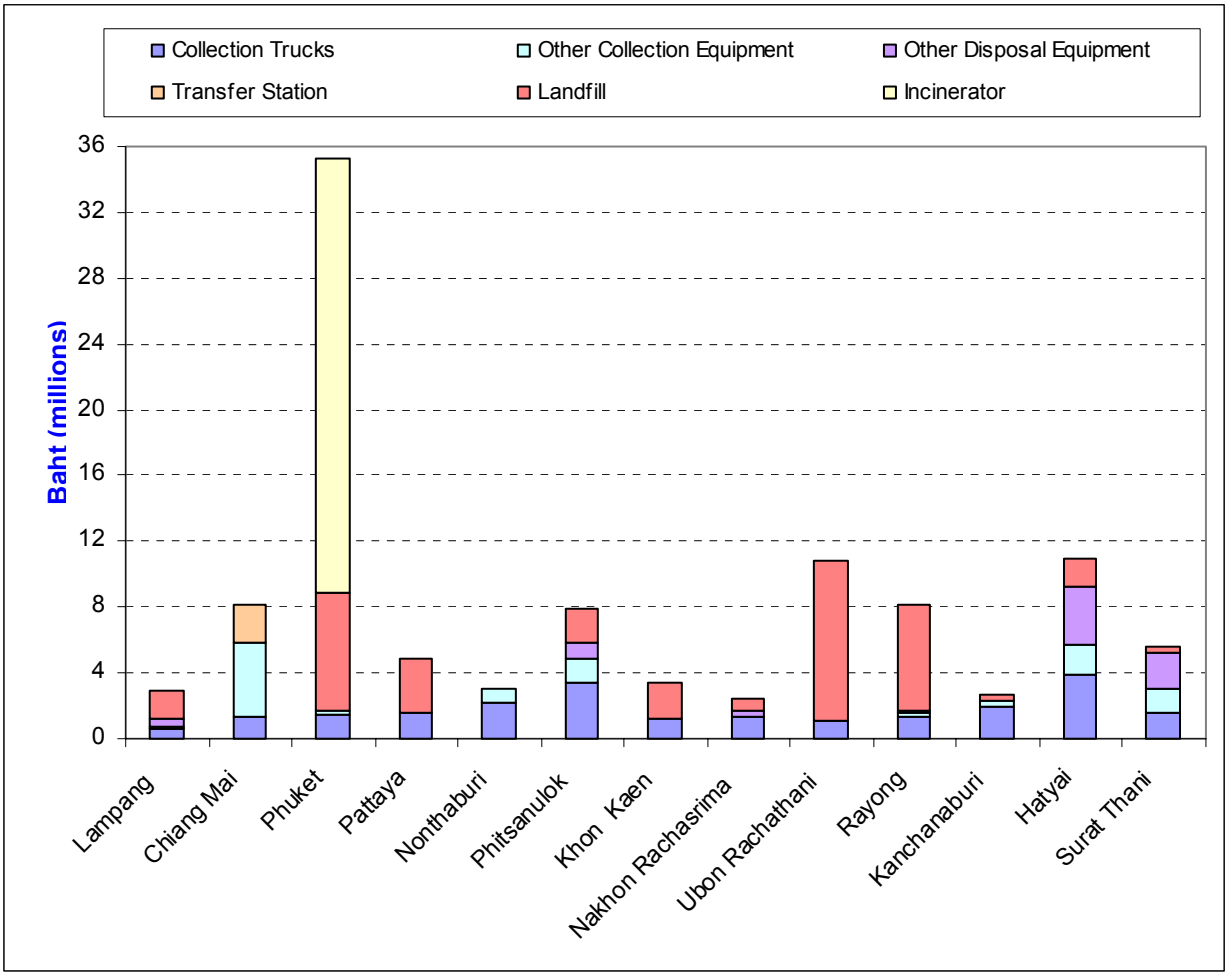
In many cases, these national funds came from the Office of Natural Resources and Environmental Policy and Planning (currently the Office of Environmental Policy and Planning or OEPP). Six of the municipalities surveyed (Chiang Mai, Phuket, Phisanulok, Khon Kaen, Hatyai, and Rayong) received funds from the OEPP's Environmental Fund. The purpose this fund is to facilitate capital development for pollution control systems and equipment in local government units, state enterprises or private companies in Thailand. Established in 1995, the Environment Fund offers a mix of subsidies and soft loans and requires a cost share of at most 30-35 % of the total project budget.

Another source of funding from the national government is the Department of Public Works, although this no longer seems to be a common source. In this survey, only Phuket reported receiving funds from this Department. Also, Surat Thani received a small amount of funding from the Ministry of Science Technology and Environment (MOSTE) for the construction of an emergency dump site.

In addition, two municipalities – Phitsanulok and Khon Kaen – reported that they received funding from a donor organization, the Danish funding agency DANCED. These funds were spent on various projects, such as an infectious incinerator, a composting plant, and a recycling program.

Figure 18 shows capital costs for solid waste management. As is apparent, the range across municipalities varies significantly. Apart from Phuket, which spent almost 800 million baht on a new incinerator in 1998, capital spending ranges between 2.5 and 11 million baht per year. Much of the variation is likely explained by limitations in the data. Many of the municipalities surveyed did not have reliable data for their capital expenditures, and the data that was collected generally covers only the last five to six years. So to some extent, municipalities like Hatyai show higher capital costs because they provided more reliable data.

Figure 18: Average Annual Capital Costs (From All Funding Sources)



Note on Capital Cost data:

Average capital costs were determined using different lifecycles for equipment as follows:

2 years - Garbage Containers and Miscellaneous Equipment (e.g. push-cart, rickshaw, collection boats, etc.)
10 years - Collection trucks, sweeping cars, and disposal equipment (e.g. dump truck, caterpillar tractor, bulldozer, weighing machine)
20 years – Landfill Facilities, Transfer Station
30 years - Incinerators

Annex A: Contacts and References

I. Municipality Addresses

Northern region:

1. Chiang Mai - Chiang Mai Metropolitan Municipality, 1 Wangsingkum Changmoi Sub-District, Amphur Muang, Chiang Mai 50000. Tel: 053-252-178

2. Phitsanulok - Phitsanulok City Hall, 1299 Boromatrilokanart Rd., Nai Muang Sub-District, Amphur Muang, Phitsanulok

3. Lampang - Lampang Metropolitan Municipality, 054 Chat Chai Road, Nai Muang Sub-District, Amphur Muang, Lampang 52000. Tel: 054-219-211

Northeastern region:

4. Khon Kaen - Khon Kaen City Hall, Prachasamosorn Rd., Nai Muang Sub-District, Amphur Muang, Khon Kaen 40000

5. Nakhon Rachasima - Nakhon Rachasima Metropolitan Municipality, Po Klang Road, Amphur Muang, Nakhon Rachasima Province, 30000. Tel: 044-242-959

6. Ubon Rachathani - Ubon Rachathani Metropolitan Municipality, 147 Srinarong Road, Amphur Muang, Ubon Rachathani 34000. Tel: 045-246-060-3 Fax:045-252-232

Central & eastern regions:

7. Nonthaburi - Nonthaburi Metropolitan Municipality, Governmental District, Rathanatibet Rd., Bangkaso Sub-District, Amphur Muang, Nonthaburi 11000. Tel: 02-589-0495, 02-589-0507-8

8. Pattaya - Pattaya City Hall, 171 Mue 6 Nong Pure Sub-District, Amphur Bang La Mung, Chonburi 20000. Tel: 038-429-125

9. Rayong - Rayong Metropolitan Municipality, 121 Taksin Mahasaja Rd., Ta Pra Du Sub-District, Amphur Muang, Rayong. Tel: 038-611-120

10. Kanchanaburi – Lakmueng Road, Ban Nua District, Amphur Muang, Kanchanaburi 71000. Tel: 034-511-502. Fax: 034-514-788

Southern region:

11. Hatyai - Hatyai Metropolitan Municipality, 445 Patchkasem Rd., Hatyai District, Songkla 90110. Tel: 074-244-592 and 074-233-277

12. Surat Thani - Surat Thani Municipality, Pakdee Anusorn Rd., Amphur Muang, Surat Thani 84000. Tel: 077-272-513 and 077-272-583

13. Phuket - Phuket City Hall, 52/1 Narison Rd, Talad Yai, Amphur Muang, Phuket 83000. Tel: 0-7621-2196. Fax: 0-7621-3374

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9. Phuket City
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14. Tourism Authority of Thailand
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15. Ubon Rachathani Metropolitan Municipality
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Annex B: Methodology and Data Limitations

I. Methodology

The methodology of this study incorporated 4 steps: (1) the design of the survey methods & questionnaires; (2) the survey; (3) the compilation, analysis and presentation of the data collected; and (4) the presentation of the results.

(1) The design of the survey methods & questionnaires

Using guidelines on benchmarking indicators from US-AEP and the World Bank, the team designed appropriate questionnaires, in Thai, to ensure accurate and appropriate reporting of data. Based on their experiences in the field, the team also included other relevant questions which it was anticipated would be useful to the study. During this process, the team worked closely with US-AEP and the World Bank and received further guidance from the Environmental Officers from Nonthaburi Municipality.

The pilot project was carried out with the metropolitan municipality of Nonthaburi. The Director of the Environmental and Health Department of the municipality, Ms. Pornsri Kictham, was responsible for reviewing and commenting on the questionnaire. On December 11, 2002, the team members held a meeting with Miss Kictham to discuss the survey activities and to test the methods and questionnaires. These were then revised and a final questionnaire and methods were developed for each of the team leaders to use in their respective regions with the remaining 12 municipalities.

(2) The survey

The remaining 12 municipalities involved in the benchmarking survey were approached by the individual teams. The teams explained the purpose of the study and worked with each municipality to identify the relevant departments and personnel who would be involved in collecting the required data.

A written questionnaire, in Thai, was then sent to the staff members identified. One to two weeks after this, the team leader and assistant visited the municipality to introduce themselves, ensure the objectives of the project were clearly understood and assist in compiling the initial information. The team assistant then conducted field visits to help in collecting the data and worked with the municipal staff to ensure the data was complete.

Throughout this process the individual teams keep in close contact in order the share their experiences and discuss methods.

(3) The compilation, analysis and presentation of the data collected

On February 9, 2003, all the team members and the project coordinator from US-AEP met in Bangkok to discuss how the data would be compiled, in order to ensure that each indicator was reached by using the same calculation. Each team then compiled its data and sent the results to the project manager to analyze. The results were presented in tables and charts, and on a master spreadsheet. In addition to the analysis of each indicator, comparisons between municipalities and relationships between indicators were charted.

(4) Presentation of results

To ensure that all stakeholders in the project would be fully informed of the results of the study, US-AEP, the World Bank and the Pollution Control Department (PCD) organized a workshop with the 13 municipalities involved in data collection and representatives from the PCD and the Ministry of Land Transport. The workshop was held during the National Convention & Grand Exhibition on Solid Waste and Toilet Technology in Bangkok from March 13-16, 2003.

The workshop set out: (a) to present the indicators and other results from the study; (b) to encourage further discussion on the differences in performance and areas for improvement; (c) to share best practices and solutions; and (d) to get feedback from the municipalities.

II. Difficulties in Data Collection

The survey team found that most municipalities lacked accurate solid waste data. In most municipalities, the data is only kept in hard copy for three years. Data that is available is not centralized, which meant the survey teams had to gather data on collection, disposal, procurement, maintenance, fees collection, accounting, etc., from different departments. In some instances, they were unable to collect accurate data.

Additionally, private companies involved in solid waste management in the municipalities concerned were often unwilling to release the information requested. This makes it difficult to compare municipalities that operate publicly with those that have contracted with the private sector for part or all of their solid waste management services.

The survey team also found that few municipalities have accurately measured the amount of solid waste that is diverted from landfills through recycling. Thus, the recycling data from this study is based on estimates gathered from several sources. Data was unavailable for some municipalities, such as Phitsanulok and Surat Thani.

Annex C: Municipal Profiles

This annex provides profiles of the 13 municipalities that participated in the solid waste management benchmarking study. The information was obtained from the field survey, the landfill survey questionnaire and the municipality websites (listed in Annex A). The information presented is more substantive for some municipalities than others depending on the degree of qualitative information obtained from the municipalities.

1. Lampang Metropolitan Municipality

General Profile

Lampang Province is 602 km north of Bangkok and lies at a height of 270 meters above sea level. The Province serves as the central transport junction to the northern provinces. Lampang Metropolitan Municipality sits on the site of a 1,300 year old city, Kala-Nakhon, and many historic structures, such as city walls, canals and temples, are found there.

The Municipality covers a total land area of 22.17 km^2 and is comprised of 8 sub-districts and 32 communities. There are four dense areas in the Municipality – the business center at the southern canal, the commercial center in front of the railway station, the residential center in the old town area, and the ceramic industrial center in Chom Pu sub-district.

The population of Lampang is approximately 70,000 and has remained practically unchanged for the past five years. Much of the population works in small industries such as ceramics.

Solid Waste Management

Among the thirteen municipalities in this survey, Lampang has gone the farthest in privatizing its solid waste management services. The Municipality has a contract with a private company for both solid waste collection and disposal. However, street sweeping and tariff collection are still carried out by the Municipality.

Officials in Lampang identified a number of problems in regard to the management of their solid waste. These include: (1) low public awareness, (2) low enthusiasm of government officials in solid waste management, (3) inappropriate landfill operation, leading to odor and insect problems, (4) high operating costs related to private sector contracts, and (5) no separation of hazardous waste from municipal solid waste.

The Municipality has it own privately-operated engineered landfill site, which has an area of 284 rai and a capacity of 1,460,000 tons. The landfill accepts 85 tons per day and is large enough to accept all of the Municipality's waste. It has a plastic liner and a leachate drainage and treatment system. Groundwater monitoring is performed yearly. No problems have been reported in the management of the landfill – the site is bulldozed and is covered with soil daily. Further, the landfill has a fence around it, and there are no scavengers reported on the site.

Due to the low revenues from fees – 1,800,000 baht in 2001 – and the high yearly fee paid to the contractor – 28,643,375 baht in 2001, or 923.24 baht/ton – the Municipality has one of the highest ratios of operating costs to operating revenues from fees (20:1) of the thirteen municipalities. They also reported spending a high percentage of their municipal budget on solid waste management (16%).

2. Chiang Mai Metropolitan Municipality

General Profile

Chiang Mai is Thailand's second largest city and capital of the northern region. It is approximately 700 km north of Bangkok. Chiang Mai is a major transportation hub for Thailand.

Chaing Mai City was built as a capital for the Meng Rai Dynasty in 1297. The city's history has been developing for over 700 years. Its unique culture makes Chang Mai one of Thailand's most visited locations and a well-known tourist destination.

Chiang Mai Metropolitan Municipality covers 40 km^2 and has 14 sub-districts, comprising the total area of Chang Moi, Hai Ya, Si Pum, Wat Kate, Chang Clan, Pa Tan and Pra Sing and part of Su Tep, Pa Dad, Pha Amm, Nong Pa Kang, Ta Sa La, Nong Hoi and Chang Pak. In recent years, the population of Chiang Mai has grown rapidly. In 2001 the registered population was 173,856. During the tourist high season, this number can be doubled.

Solid Waste Management

The city's growth, both in economic and social terms, has brought many problems, particularly in the amount of solid waste produced by residents and visitors. Industrial enterprises have also added to the volume of solid waste in the city.

Narrow roads within the Municipality are a problem for the collection and transportation of solid waste. In addition, surveys have found that only 85% of trucks are in operating condition, leading to further problems in collection.

The Board of Investment of Thailand has noted that Chiang Mai Metropolitan Municipality has the following solid waste problems:

1. Solid Waste from communities – At present, Chiang Mai Municipality has to deal with the problem of rising quantities of solid waste from the expansion of residential and commercial areas due to the economic and social development of the city.
2. Industrial waste – According to a survey by the Chiang Mai industry office, the majority of industries utilize natural resources in connection with agricultural activities. This leads to a surplus of unused substances and more waste.
3. Infectious waste from public heath services – Mostly this comprises waste from medical sources, including organic waste such as flesh or organs and chemical waste from experiments. Some public health services still lack proper treatment methods and some infectious waste is mixed with the communities' solid waste. There is, therefore, a high risk of disease.

The Metropolitan Municipality disposes of solid waste in an engineered landfill which is operated by the private sector. 2.57% of waste is separated for recycling prior to disposal. The landfill is privately operated using bulldozers and soil from the site to cover solid waste daily. The landfill has an HDPE liner and a leachate drainage and treatment system. Groundwater monitoring is performed 4 times a year. The landfill has a fence around the site to deter scavenging. The site is clean and well operated, but there is no separation of hazardous waste from the municipal solid waste.

The operation and maintenance costs of the Chiang Mai Metropolitan Municipality are in the higher range at 1,185 baht/ton. Similar to Lampang, the city spends a great amount of its income on solid waste management. Among the 13 municipalities studied, Chiang Mai has the greatest MSW expenditure/total expenditure at 18.5%. It also has a relatively high operating cost to operating revenue from fees at 9.42:1 baht.

3. Phuket Metropolitan Municipality

General Profile

Phuket, situated in the Indian Ocean, is Thailand's largest island and the smallest province in the southern region of the country. It is 867 km from Bangkok. Its 39 small islands cover an area of about 543 km^2. Phuket is a major tourist attraction. The surrounding waters contain a wide variety of marine life, and the town is noted for its Sino-Portuguese architecture.

The island is divided into three districts (Thalang in the north, Kathu in the west, and Muang in the south) and 17 sub-districts. The cities of Phuket and Patong have their own city governments, with elected city councils, with the leading member of each council serving as mayor. Phuket Metropolitan Municipality covers an area of 12 km^2. According to the official Registration Record (2001), the resident population of the Muang Municipality was 72,754 persons. During the peak tourist season, this number would be doubled.

Solid Waste Management

Phuket's major industry is tourism and its solid waste generation rate is high (about 1.38 kg per person per day). In the past, all of the islands' waste was disposed of at a 120 rai (0.192 km^2) engineered landfill site. In 1998, the province of Phuket received a grant from the government to expand the landfill by building an additional layer, which would extend its life for a further 7 years. Later, due to land limitation, the island installed two incinerators – a 250-ton incinerator for regular waste and an infectious waste incinerator. The 250-ton incinerator, which the operators claim is operating at capacity, has several ongoing problems, including opposition from the public, a high cost of operation and maintenance, and a high capital cost.

Recently, the City gave the private sector the opportunity to partially subcontract the collection of solid waste and fully subcontract the collection of fees and incinerator operation. Phuket is the only city in Thailand that charges the community for both solid waste collection and disposal fees. After the private company has collected these fees, it returns only 1,400,000 baht/year of the revenue to the city.

About 75% of the total waste collected is disposed of in the incinerator, while 12% of waste is disposed of at the engineered landfill operated by Phuket province. The landfill operates by using soil from the site to cover the solid waste. The landfill has a geotextile and clay liner, as well as a leachate drainage and treatment system. Groundwater monitoring is performed weekly. Even though the landfill has a fence around it, 40 scavengers are present in the site. The site is clean and well operated and attracts a great deal of public interest as it is located next to a sensitive wetland area.

The operation and maintenance cost of Phuket Metropolitan Municipality for solid waste management is 1,592 baht/ton. Among the 13 municipalities, Phuket has the greatest operating cost per operating revenue from fees at nearly 42:1 baht. Although the city spends a large amount of money on solid waste management, expenditure on MSW per total municipal expenditures is relatively low at 12.7 %.

4. Pattaya City

General Profile

Pattaya City is in Chonburi Province, located on the shoreline of the Gulf of Thailand, 147 km southeast of Bangkok. Over the last 50 years, Pattaya has grown from a small village to a major tourist destination. In 1979, Pattaya was designated as a City.

Pattaya City is divided into 4 sub-districts (Nakluea, Nong Prue, Huay Yai, Nong Pralai), including a number of islands, with a land area of 53.44 km^2. Koh Lan (Coral Island), is the largest offshore island and a major tourist destination. The City has its own government with an elected council, the leading member of which serves as mayor. The registered population of the city in 2001 was 85,533. Pattaya City has a high percentage of unregistered persons – as many as 500,000 – mostly working in the tourist industry.

Solid Waste Management

The private company contracted to collect solid waste only serves 70% of the contract area. The remaining uncollected waste causes an odor problem in the city. In addition, there are many sanitary problems found at the transfer station, including odor, insects, scavengers and leachate.

Pattaya City employs the Chat Thai Company to collect solid waste in 90% of the city area and transport it to the city's engineered landfill located in Kao Mai Kaew District. About 100% of the collected solid waste is transported to a transfer station before being transferred to the landfill. As the transfer station is temporary, the quality of the management is quite poor.

Pattaya City has its own engineered landfill site and transfer station. The area of the landfill in use is 50 rai from the total available area of 140 rai. The landfill is of sufficient size to accommodate all the waste from the transfer station (250 ton/day). The landfill is operated using bulldozers and soil from the site to cover the solid waste daily. The landfill has an HDPE liner and a leachate drainage and treatment system. Although the landfill has a fence in place around it, 25 scavengers have been identified. The landfill management is effective; no issues or complaints have been raised. There is currently no hazardous waste separation before disposal; therefore there is a possibility of hazardous waste contamination in areas near the landfill.

Koh Lan sends 4 tons of solid waste a day to its incinerator. However, the incinerator can only dispose of 1 ton/day. The excess waste is sent to the landfill at Maikeaw Island by boat. Occasionally, irresponsible crews have been known to dump solid waste into the sea during transportation.

The annual operation and maintenance costs of Pattaya Metropolitan Municipality for solid waste collection and disposal are 874 baht/ton, which is in the middle range of the 13 municipalities surveyed. The MSW expenditure as a percentage of total municipal expenditure is, at 16.3%, in the highest range.

5. Nonthaburi Metropolitan Municipality

General Profile

Nonthaburi Metropolitan Municipality is in Nonthaburi Province, which is located east of the Chao Phraya River. The town is only 20 km from Bangkok and is accessible by road or river. Nonthaburi Municipality is divided into 5 sub-districts (Suan Yai, Talat Kwan, Tha Saiy, Bang Kean, Bang Krasaw) which cover a total of 38.9 km^2. The population of the Municipality in 2001 was 270,609. Most of the people in this Municipality work in Bangkok.

Solid Waste Management

Nonthaburi Metropolitan Municipality does not own a disposal site. The Municipality disposes of its solid waste in the Nonthaburi Province Administration's open dump at a low service charge of 27.10 baht/ton. The Municipality claims that this is more cost effective than operating its own disposal site.

Only two problems were reported in Nonthaburi: the collection system does not cover the entire area due to the narrowness of some roads; and there is low awareness among the population of solid waste separation and the waste collection schedule.

6. Phitsanulok Municipality

General Profile

Phitsanulok Province is approximately 377 km north of Bangkok and is located at an elevation of approximately 40 m. above sea level. Phitsanulok Municipality covers an area of 18.26 km^2, composed of only 1 sub-district. It is divided into two parts by a river. The east side is a commercial and communication zone, and the west side contains residential, institutional, governmental and military zones. This province is the transit junction to the north and northeast regions of Thailand. The population of the Municipality was reported to be 89,976 persons in 2001.

Solid Waste Management

Phitsanulok Province is well known for its successful recycling program. It has reduced its waste by more than 50% through the efforts of a privately owned recycling company and a campaign sponsored by the Municipality.

After the recyclable waste is separated at home, it is collected and sent to the Municipal engineered landfill. In the past, the Municipality hired a private company to take care of its solid waste and experienced many problems. The Municipality now finds that it has fewer problems collecting and disposing of its solid waste itself. Due to the Mayor's vision and concern for the environment, this Municipality has had many successful waste management programs including recycling, the separation of organic waste and the separation of hazardous waste.

However, collection remains a problem for solid waste management in the Municipality. The trucks used to collect and transfer waste are not in appropriate operating condition (with leakage of wastewater reported). Furthermore, the leachate collection and treatment lagoon found at the disposal site is inadequate in size.

7. Khon Kaen Metropolitan Municipality

General Profile

The Province of Khon Kaen is located in the central area of the northeastern region of Thailand on the Korat plateau, about 100-200 m above sea level. It lies in the geographical heart of Thailand's sprawling northeast plateau, about 445 km from Bangkok.

Most of Khon Kaen Province's land area is agricultural, followed by forested area. Khon Kaen is the third largest province in the region, after Nakhon Ratchasima and Ubon Ratchathani.

Solid Waste Management

The Metropolitan Municipality provides 200 liter garbage containers for household waste. Commercial businesses have to provide their own containers. There are many types of trucks, including 4-wheel pickup trucks, for collection along the narrow roads of the Municipality.

The Metropolitan Municipality landfill site is an engineered landfill in Kham Bon District, which is 17 km from the Municipality. It has been operating for nearly 18 years and is now almost full. The Municipality plans to transfer operations to a new site about 40 km further away. However, the proposed site has raised objections from local people and, as a result, the existing site will be used for another 5 years. Since the landfill has been in operation for so long, there are a large number of scavengers living inside the landfill, including children, elderly adults and stray dogs.

The incinerator for infectious waste disposal is located next to the landfill. The Municipality collects all infectious waste in a special truck. The collection and disposal fee for infectious waste is higher than for non-hazardous waste and many of the small infectious waste generators are not willing to pay for this service.

8. Nakhon Rachasima Metropolitan Municipality

General Profile

Nakhon Ratchasima Metropolitan Municipality is in the province of Nakhon Rachasima in the northeastern region of Thailand. Nakhon Rachasima Municipality is situated at a height of 150-300 m

above sea level and is about 255 km from Bangkok. The province has a total area of 20,493.964 km², which is about 12.12% of all the land in the northeastern region. Most employed persons in Nakhon Rachasima Province work in the agricultural, hunting, and forestry sectors, followed by the production and the wholesale/retail sectors.

Nakhon Rachasima Metropolitan Municipality is in Muang District, which is divided into 24 Sub-Districts. The Municipality covers 37.50 km² and has a total population of 174,322.

Solid Waste Management

Nakhon Rachasima Metropolitan Municipality has designated land for a new sanitary landfill. However, as in Khon Kaen, this landfill could not be developed due to public opposition. As an alternative, the Municipality is using Army property as a temporary dump, while negotiating with nearby residents to propose a new sanitary landfill site. Hazardous waste is collected separately and sent to a privately owned hazardous waste disposal company.

The two main problems in solid waste management in Nakhon Rachasima Municipality are: (1) low population awareness of solid waste separation, and (2) the low rate of fee collection (about 30%).

9. Ubon Rachathani Metropolitan Municipality

General Profile

Ubon Rachathani Metropolitan Municipality is in Ubon Rachathani Province, about 630 km northeast of Bangkok. Most of the land in the province is highlands. The Mae Kong River forms the border between the province and the People's Democratic Republic of Laos. The majority of the population works in the agricultural sector, mostly in livestock farming, simple agricultural processing, agricultural services, fishery, and forestry.

Ubon Ratchathani Metropolitan Municipality covers an area of 29.04 km², with a population of 105,150 in 2001. There is a high population density, comprising residential and commercial use, in Muang District.

Solid Waste Management

The solid waste generated in the Metropolitan Municipality is 85-100 tons/day. As some areas of the Municipality are not covered by collection services, due to the narrow roads, only about 80% of solid waste generated is collected. This leaves about 17 - 20 tons of waste uncollected each day.

The Metropolitan Municipality has been disposing of its solid waste in an open dump on Army property at Warin Cham Rab District, about 6 km from the Municipality, for more than 10 years. In 1997, a new landfill located in Don Meo village was constructed. However, it could not become operational due to political problems. So the Municipality continued to use the previous landfill, which began to overflow. The landfill site has since been filled up and the Army has asked the Municipality to conclude operations at the site. The Metropolitan Municipality now has to dispose of solid waste via the Warin Cham Rab Municipality with a service charge of 130 Baht/ton.

10. Rayong Metropolitan Municipality

General Profile

Rayong Metropolitan Municipality is in Rayong Province on the east coast of Thailand, about 179 km from Bangkok. It is divided into 4 sub-districts (Ta Pradu, Nuen Pra, Cheng Nuen, Pak Nam) which cover an area of 16.95 km². The population of the Municipality in 2001 was 55,942. Most of the people in this Municipality work in the tourism and industrial sectors.

Solid Waste Management

All solid waste is collected and disposed of in a sanitary landfill located in the Pak Nam sub-district. The Metropolitan Municipality policy focuses on solid waste management and it promotes many successful solid waste programs including a solid waste bank, organic waste separation, trading waste for eggs, and hazardous waste separation. All hazardous waste is separated at home and picked up separately before being sent to a hazardous waste disposal company.

Reported problems of solid waste management in the Rayong Metropolitan Municipality are minor. They include: (1) a shortage of collection/disposal equipment, and (2) an odor problem during the rainy season due to the inefficient drainage system.

Rayong Metropolitan Municipality has it own sanitary landfill site with a total area of 38.5 rai with about 10 rai unused. The landfill is sufficient to accept all the waste that is delivered to it (c. 72 tons/day). The landfill is municipality operated using bulldozers and soil from the site to cover the solid waste daily. The landfill has an HDPE liner and a leachate drainage and treatment system. The groundwater is monitored via 2 monitoring wells and monitoring is performed twice a year. The landfill has a fence around it and, to date, there are no scavengers living in the landfill. Only 35 scavengers are working during the daytime. The landfill management is effective and no problems concerning the landfill have been reported.

11. Kanchanaburi Municipality

General Profile

Kanchanaburi is located where the Kwae Yai and the Kwae Noi Rivers unite to form the Mae Klong River and is 130 km from Bangkok. It is very well known for its historic sites and natural areas. Kanchanaburi Municipality is divided into 5 sub-districts (Ban Neua, Ban Tai, Thalaw, Pakprak and Tha Makham), which cover an area of 9.16 km². The population of the municipality in 2001 was 39,065.

Solid Waste Management

The Municipality takes care of the collection and disposal of all solid waste. Kanchanaburi Municipality has a sanitary landfill located in the Nongrong sub-district of the Panomthon District. However, this site is not operational due to local opposition. Currently, the municipality disposes all of its solid waste – including hazardous waste – in a nearly full open dump site in the Pak Prak sub-district. The total area of the 80 rai landfill in use is 70 rai.

The site has a clay liner, no leachate drainage and treatment system and no groundwater monitoring. The landfill is operated using bulldozers and the surface is left open until the pit is full before covering it with soil. The landfill has no fence around it and 10 scavengers are found in the landfill.

Among the 13 municipalities, Kanchanaburi has, at 6.3%, the lowest expenditure on SWM as a percentage of total municipal expenditure.

12. Hatyai City Metropolitan Municipality

General Profile

Hatyai is the largest district in Songkhla Province in the south of Thailand. The district has grown into the commercial, transportation, communication, educational, and tourism center of the south and it was declared a municipality in 1995. The city of Hatyai covers an area of 21 km^2 and is 28 km from the city of Songkhla. It is the gateway to the neighboring countries of Malaysia and Singapore. Hatyai is a well-known tourist destination, catering to approximately 2,300,000 tourists annually. About 800,000 of these are from overseas and the rest are Thai. The annual income generated from tourism is about 20,000 million Baht per year.

The records kept during the past five years indicate that the Hatyai Metropolitan Municipality population has remained practically unchanged. In 2001 it was 157,806. The unregistered population is estimated to be around 150,000.

Solid Waste Management

The city operates its own solid waste collection and disposal. The solid waste disposal site has an odor and an insect problem. Due to limited funds, the city claims that it is not possible to fund a cover for the site and so they leave the surface open until the pit is full. It is expected to reach capacity in April 2003. The Municipality has designated land for a new sanitary landfill, but due to public opposition it remains undeveloped.

Even though Hatyai City is a commercial center, the city was not well planned and the roads are narrow and unorganized. Due to the narrow roads and high level of traffic during the daytime, solid waste collection is carried out at night. During the daytime, solid waste is left at the curbside, creating an unpleasant sight. Among the 13 municipalities, Hatyai has the greatest number of collection staff at 1.90 staff/ton.

At present, all solid waste is disposed of in a 135 rai controlled dump at Kuan Lung sub-district. Hazardous waste is separated out. The landfill has a clay liner and a leachate drainage and treatment system. Monitoring of the groundwater (drawn from 10 monitoring wells) is performed two times a year. The landfill is operated using bulldozers and soil from outside the site to cover the solid waste. The landfill has a fence around it, but there are still a large number of scavengers (c. 120) working in the landfill. The landfill management is effective and no problems about the landfill have been reported. Hazardous waste is not accepted at this landfill.

13. Surat Thani Municipality

General Profile

Surat Thani is the largest and most important province in the South, located 644 km from Bangkok. It has high plateaus and mountains covered with valuable wood forest to the west and low basins in the central and eastern seashore area. There are a large number of islands along the coast and two major rivers, the Tapi and Phum Duang.

Surat Thani Municipality covers an area of 69 km^2 and in 2001 had a registered population of 114,840. The area covers 6 sub-districts: Talad, Makham Tia, Bang Bai Mai, Bang Chana, Bang Soong and Klong Chanak. Four poorer districts are found in Surat Thani Municipality: Vipawadi Military Camp Community, Nong Bua Community, Lhang Klang Community and Si Thani -Yang Ngam Community.

Solid Waste Management

The Municipality takes responsibility for the collection and disposal of all solid waste. The landfill operated for more than 20 years by the Municipality reached its capacity some time ago. The Municipality sought and assigned land for a new sanitary landfill, but this could not be developed due to public opposition. Therefore, the Municipality extended the capacity of the old landfill by hiring a private company to evacuate decomposed soil (without knowing where this soil then went) to make more room for additional solid waste. This site could dispose of 160 tons of solid waste daily. The site contains 4 pits. An HDPE liner was used in one pit and clay liners were applied to the others. The landfill has a leachate drainage and treatment system and groundwater monitoring had been carried out three times a year. Bulldozers cover the solid waste with soil from the site. Despite the fence around the landfill, 20 scavengers are reported.

At present, all solid waste is disposed of at a 40 rai open dumpsite that does not offer hazardous waste separation. There is no hazardous waste separation before disposal; therefore, there is a possibility of hazardous waste contamination near the landfill area.

Among the 13 municipalities, Surat Thani, together with Kanchanaburi, has the lowest operating and maintenance cost at 388 baht/ton. The operating cost/operating revenue from fees is 8:1 baht.

Annex D: Municipal Tariff Structures

Municipal tariff structures were not available for Lampang, Phitsantulok and Ubon Rachathani Municipalities.

Chiang Mai Metropolitan Municipality

Descriptions	Baht
Monthly collection fees for buildings and complexes	
a. Less than 20 liters/day (charge per month)	40
b. Between 20-500 liter/day (per 20 liter)	40
c. Between 500 liter-1 m^3/day (charge per month)	2,000
d. Additional charged per every 0.0-1 m^3	2,000
Collection fees for markets, industrial plants or any place that produces a large amount of waste	
a. Less than 1 m^3/day (charge per month)	2,000
b. More than 1 m^3/day (charge per month)	1,000
Collection fees charged by the trip	
a. Less than 1 m^3/trip	150
b. More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Collection fees for sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	250
b. Additional charge for every 0-0.5 m^3 addition	150
c. Additional charge for every 0.5-1.0 m^3 addition	250
Collection fees for infectious waste	
a. Monthly Fees	
-Less than 2 kg or less than 13 liter	300
-Additional charge per every 0-2 kg or every 0-13 liter	300
b. Collection and disposal fees per trip	
-Additional charge for waste less than 75 kg or 500 liter	3,000
-Additional charge for waste more than 75 kg or more than 500 liter	400
(charged by every 0.0-75 kg or 0.0-500 liter)	400

Phuket Metropolitan Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes	
20 liter/day (charge per month)	30
b. Additional charge for every addition 0-20 liter	30
Collection fees for household waste	
a. 500-1,000 liter/day	1,500
b. Additional charge every addition 0-1,000 liter	1,500

Nonthaburi Metropolitan Municipality

Descriptions	Baht
Collection fees for household waste	
Monthly price for buildings and complexes	
a. 20 liter/day (charge per month)	20
b. Between 20-40 liter/day (charge per month)	40
c. Between 40-60 liter/day (charge per month)	60
d. Between 60-80 liter/day (charge per month)	80
e. Between 80-100 liter/day (charge per month)	100
f. Between 100-200 liter/day (charge per month)	200
g. Between 200-300 liter/day (charge per month)	300
h. Between 300-400 liter/day (charge per month)	400
i. Between 400-500 liter/day (charge per month)	500
j. Between 500 liter and 1 m^3 (charge per month)	1,500
k. Charge per every additional 0.0-1 m^3	2,000
Collection fees charged by the trip	
a. Less than 1 m^3/trip	150
b. More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Collection fees for sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	250
b. Additional charge for every 0-0.5 m^3 addition	150
c. Additional charge for every 0.5-1.0 m^3 addition	250
Permission license fees	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000
c. Portable Restroom setup license (per license)	1,000
d. Portable Restroom Mobile license (per license)	1,000

Pattaya City

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes 20 liter/day (charge per month)	20
b. Between 20-40 liter/day (charge per month)	20
a. Between 40-160 liter/day (charge per month)	30
b. Between 160-260 liter/day (charge per month)	35
c. Between 260-500 liter/day (charge per month)	40
d. Between 500 liter and 1 m^3 (charge per month)	1,500
e. Additional charged per every 0.0-1 m^3	1,500
Collection fees charge by the trip	
a. Less than 1 m^3/trip	150
More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Collection fees sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	100
b. Additional charge for every 0-0.5 m^3 addition	75
c. Additional charge for every 0.5-1.0 m^3 addition	100
Permission license fees	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000

Khon Kaen Metropolitan Municipality

Descriptions	Baht
Collection and Disposal of Infection Waste	
a. Monthly collection and disposal fees	
-Less than 2 kg or less than 13 liter	300
-More than 2 kg or more than 13 liter, the fee will be charged for every 0.0-2 kg or	
0.0-13 liter	300
b. Collection and disposal fees per trip	
-Travel distance less than 50 km	3,000
-Additional charge for waste less than 75 kg or 500 liter	400
-Additional charge for waste more than 75 kg or more than 500 liter, will be charged by every 0.0-75 kg or 0.0-500 liter	400
c. Disposal fees with permission to collect and transfer (charge by the kg)	16
Permission license fees (the certificate follows Title 19)	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000
c. Collection and transport of infection waste (per license)	10,000
d. Disposal of infection waste (per license)	10,000

Nakhon Ratchasima Metropolitan Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes 20 liter/day (charge per month)	20
b. Between 20-40 liter/day (charge per month)	50
c. Between 40-60 liter/day (charge per month)	80
d. Between 60-80 liter/day (charge per month)	120
e. Between 80-100 liter/day (charge per month)	160
f. Between 100-200 liter/day (charge per month)	300
g. Between 200-300 liter/day (charge per month)	500
h. Between 300-400 liter/day (charge per month)	750
i. Between 400-500 liter/day (charge per month)	1,000
j. Between 500-750 liter/day (charge per month)	1,500
k. Between 750-1,000 liter/day (charge per month)	2,000
l. Charge for every additional 250 liter	500
Collection fees charge by the trip	
a. Less than 1 m^3/trip	150
b. More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Permission license fees	
a. Collection and transport of waste license (per license)	5,000

Rayong Metropolitan Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes	
20 liter/day (charge per month)	10
b. Between 20-40 liter/day (charge per month)	40
c. Between 40-60 liter/day (charge per month)	50
d. Between 60-80 liter/day (charge per month)	100
e. Between 80-100 liter/day (charge per month)	120
f. Between 100-200 liter/day (charge per month)	160
g. Between 200-300 liter/day (charge per month)	280
h. Between 300-400 liter/day (charge per month)	360
i. Between 400-500 liter/day (charge per month)	500
j. Between 500 liter and 1 m^3 (charge per month)	2,000
k. Additional charged per every 0.0-1 m^3	2,000
Collection fees charge by the trip	
a. Less than 1 m^3/trip	150
More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Collection fees sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	250
b. Additional charge for every 0-0.5 m^3 addition	150
c. Additional charge for every 0.5-1.0 m^3 addition	250
Permission license fees	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000

Kanchanaburi Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes	
20 liter/day (charge per month)	20
b. Between 20-40 liter/day (charge per month)	40
c. Between 40-60 liter/day (charge per month)	60
d. Between 60-80 liter/day (charge per month)	80
e. Between 80-100 liter/day (charge per month)	100
f. Between 100-200 liter/day (charge per month)	150
g. Between 200-300 liter/day (charge per month)	200
h. Between 300-400 liter/day (charge per month)	300
i. Between 400-500 liter/day (charge per month)	500
Collection fees for market, industrial plant or any place that produces a large amount of waste	
a. Less than 1 m^3/day (charge per month)	2,000
b. More than 1 m^3/day (charge per month)	1,000
Collection fees charge by the trip	
a. Less than 1 m^3/trip	150
b. More than 1 m^3/trip charge per additional 0.0-1 m^3	150
Collection fees sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	250
b. Additional charge for every 0-0.5 m^3 addition	150
c. Additional charge for every 0.5-1.0 m^3 addition	250
Permission license fees	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000

Hatyai City Metropolitan Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes	
20 liter/day (charge per month)	20
Additional charged per every 0.0-20 liter	20
b. Between 500 liter and 1 m^3 (charge per month)	1,000
Additional charged per every 0.0-1 m^3	1,000
Collection fees charge by the trip	
a. Less than 1 m^3/trip	100
More than 1 m^3/trip charge per additional 0.0-1 m^3	100
Collection fees sanitary/fecal waste by the trip	
a. First 0-1 m^3 (charge per trip)	100
b. Additional charge for every 0-0. 1.0 m^3	50

Surat Thani Municipality

Descriptions	Baht
Collection fees for household waste	
a. Monthly price for buildings an complexes	
20 liter/day (charge per month)	20
b. Between 20-40 liter/day (charge per month)	30
c. Between 40-60 liter/day (charge per month)	50
d. Between 60-80 liter/day (charge per month)	75
e. Between 80-100 liter/day (charge per month)	160
f. Between 100-200 liter/day (charge per month)	240
g. Between 200-300 liter/day (charge per month)	400
h. Between 300-400 liter/day (charge per month)	560
i. Between 400-500 liter/day (charge per month)	720
j. Between 500 liter and 1 m^3 (charge per month)	2,000
k. Additional charged per every 0.0-1 m^3	2,000
Collection fees charge by the trip	
a. Less than 1 m^3/trip	150
b. More than 1 m^3/trip charge per additional	
0.0-1 m^3	150
Collection fees for sanitary/fecal waste by the trip	
a. First 1 m^3 (charge per trip)	250
b. Additional charge for every 0-1.0 m^3 addition	150
Lump sum collection fees	
a. Residences, Offices, Commercial and	
Corporations (charge per truck per trip)	500
b. Governmental Institutions (charge per truck per trip)	500
c. Residence of Municipality Employees	
(charge per truck per trip)	400
d. Hospital, Hotel, other places that produces a	
large amount of waste (will be charge by the trip)	300
Permission license fees (the certificate follows Title 14)	
a. Collection and transport of waste license (per license)	5,000
b. Disposal license (per license)	5,000